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A consolidation of Electrical World, Electrical Engineer and American Electrician

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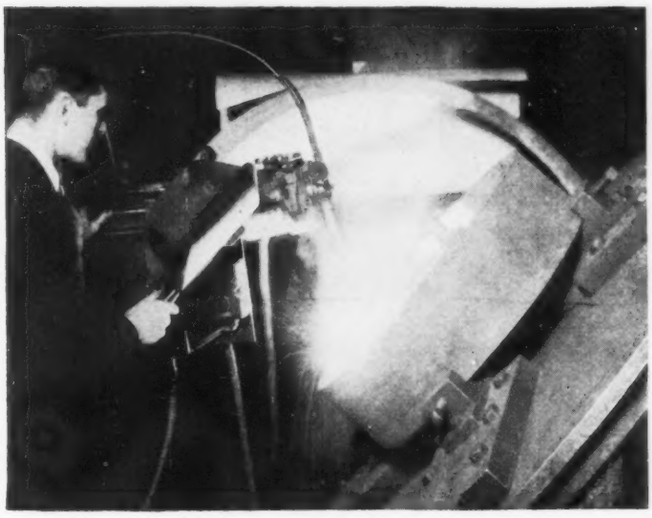

Automatic fillet welding

JUNE 27, 1931

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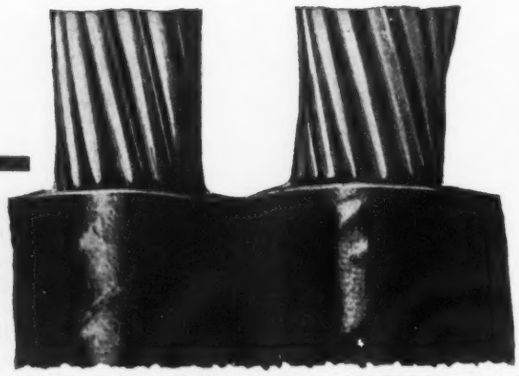

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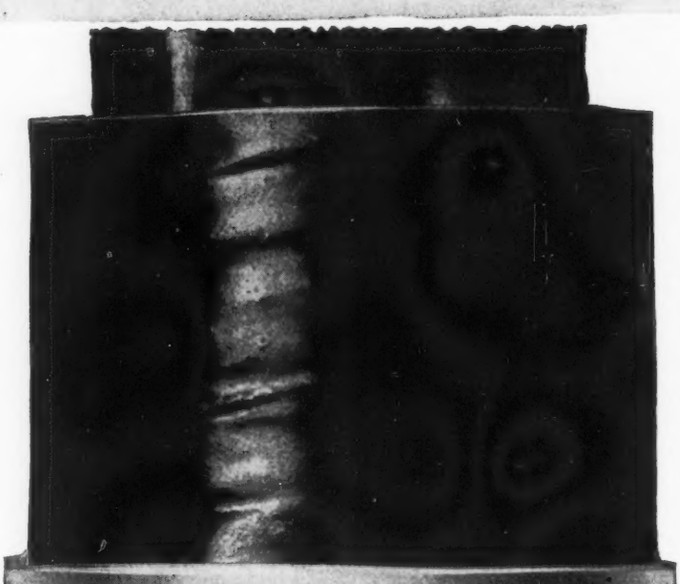

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ELECTRICAL WORLD

for the Week Ending

June 27, 1931

Research is the trade of new facts for new dollars. It's the handwriting on the wall—the inscription over the door of opportunity at the entrance to the Cathedral of Modern Industry. The door of opportunity is open. Science is holding out to you the key.

MAURICE HOLLAND,
National Research Council.

Tenney merged with New England Power

—**Largest utility consolidation** for months is announced at Boston. North Boston Lighting Properties, with operating companies extending from the New Hampshire border to Boston Edison territory, to become part of the larger organization—*p. 1202.*

—**Space limitations overcome** in urban substations by applying unit design to layout of multifloor structures. Facilitates allowance for inspection and maintenance, most direct routes for circuits and adaptation to odd-shaped floor areas—*p. 1224.*

Idaho's energy tax to be contested

—**Bagnell Dam outdoor features** are a distinguishing part of the big new development of the Union Electric Light & Power Company on the Osage River. Industrial revolution of the Missouri Ozarks impends—*p. 1212.*

—**Utah Power & Light Company** raises the same constitutional issue that is to the fore in South Carolina, asserting that a tax on power transmitted from one state to another is a burden on interstate commerce—*p. 1203.*

—**Additions from excess profits** must not be capitalized, says Wisconsin Railroad Commission in telephone valuation case, and decline in commodity prices must also be taken into consideration in fixing rate base—*p. 1206.*

—**Has the beginning of the end** of the business depression dawned? Utility financing has reached a new high weekly record, and interest rates on light and power issues are the lowest in the history of the industry—*p. 1257.*

One man operates fourteen soaking pits

—**Solitary operator runs plant** of Aluminum Company of America as regards the temperature of electrically heated line of pits and the direction by signal lights of the mill and gantry cranes used with the pits—*p. 1216.*

—**Surges on transmission lines** can now be detected by flexible and compact indicators mounted on either steel towers or wooden poles, thereby reducing amount of ground patrolling and overhead inspection—*p. 1219.*

—**Electrical market is widened** by lowering wiring cost to extent permitted by safety, says J. D. Noyes. Contractors, manufacturers, dealers, utilities and public benefit from increased opportunity to use electric service—*p. 1221.*

Breaker duty and circuit characteristics

Tenney-New England Power Merger Plans —New Group of Eleven Subsidiaries

PLANS for one of the most important utility mergers ever consummated in New England were made public on Wednesday in an announcement by Frank D. Comerford, president of the New England Power Association, and Colonel Charles H. Tenney, president of the North Boston Lighting Properties, to the effect that these groups have arranged for a consolidation of operating companies in northeastern Massachusetts extending from the New Hampshire border to the territory of the Edison Electric Illuminating Company of Boston. The merger is subject to the approval of the stockholders of the North Boston Lighting Properties, many of whose larger holders have already sanctioned the arrangement. The assets of the New England organization were $328,332,276 and those of the North Boston group were $34,138,298 at the close of 1930, and the operating revenues for 1930 were $38,228,479 and $10,962,749 respectively. Colonel Tenney has been a director of the Power Association for more than a year, and negotiations looking toward the merger have been under way for many months.

Under the plan the nine operating companies of the North Boston group in Essex, Middlesex and Suffolk Counties and the Lowell and Lawrence units of the New England Power system will become subsidiaries of the Massachusetts Power & Light Associates, itself a subsidiary of the Power Association. The eleven operating companies which will thus be grouped into a single unit are the Beverly Gas & Electric, Eastern Massachusetts Electric (a Tenney wholesale distributor of electricity), Gloucester Electric, Haverhill Electric, Lawrence Gas & Electric, Lowell Electric Light, Malden Electric, Malden & Melrose Gas, Salem Electric, Salem Gas, and the Suburban Gas & Electric Company (Revere and Winthrop). The Tenney properties are already interconnected with the Boston Edison system and thence with the New England Power system, but it is likely that the co-ordination of the Tenney and New England systems will require further interconnection and engineering developments of an important character in view of the geographical position of the Tenney properties with relation to the transmission system of the New England organization.

As a part of the general agreement, the New England Power Association will acquire the stock of Charles H. Tenney & Company, the managerial, engineering and financing organization of Boston which has built up a system of utilities in and out of New England during the past 30 years which at times have exceeded $75,000,000 in invested capital. The Tenney company will continue to supervise the operations of the North Boston Lighting Properties and other important operating utilities.

Terms of New England offer

The Massachusetts Power & Light Associates was created under a declaration of trust dated January 1, 1931, as a holding company for shares of North Boston Lighting Properties, the Lawrence and Lowell companies and others. North Boston share-trust certificate holders are offered preferred and common shares of the Associates as follows in exchange for their interests:

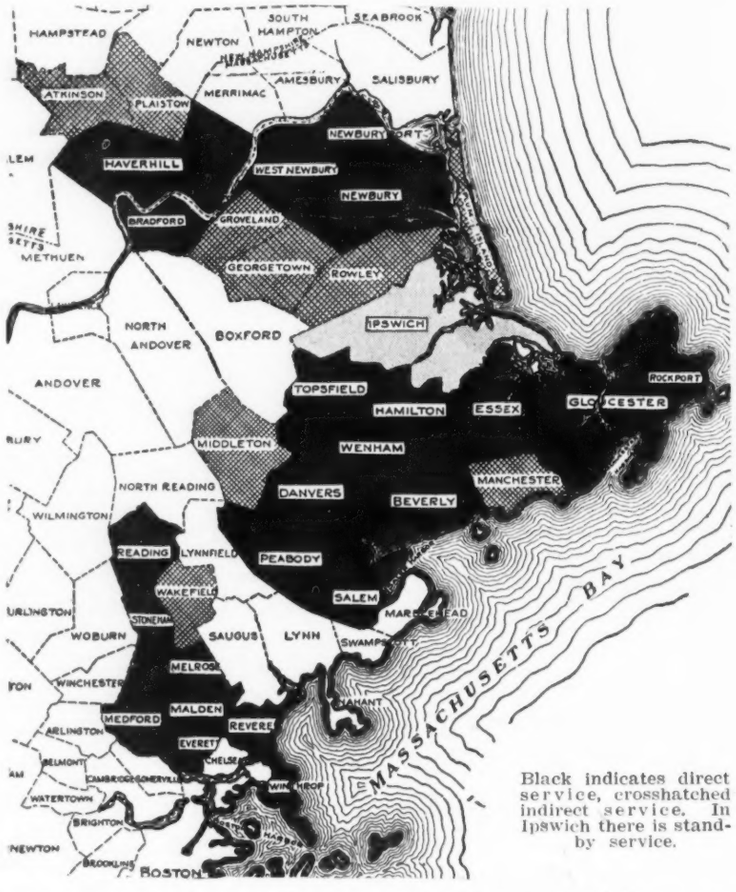
For each preferred share of North Boston, 1.65 shares of two-dollar preferred stock of the Associates and 0.5 share of common.

For each common share of North Boston, two shares of two-dollar preferred and 1.5 shares of common stock of the Associates.

The common stock of the Associates will become exchangeable between March 1, 1932, and March 1, 1942, in the ratio of one share of class A International Hydro-Electric System common stock to four shares of Massachusetts Power & Light Associates common. Cash dividends at the rate of $2 per year are now being paid by class A International Hydro-Electric.

On the assumption of a 100 per cent exchange of shares of North Boston Lighting Properties under this offer and any similar offer made to shareholders whose shares are not deposited under the share-trust agreement, the outstanding capitalization of the Massachusetts Power & Light Associates will initially be 1,336,878 shares of two-dollar preferred stock, no par value; 368,520 shares of two-dollar second preferred and 1,815,718 shares of no-par common.

Commenting upon the advantages of the proposed merger, President Comerford said in part that, combined, these organizations will be able to resist more vigorously attempts of outside interests to acquire New England properties, that the merger inevitably means a more intensive development of productive resources in northeastern Massachusetts and will extent to that territory the advantages of the Tewksbury station, southern terminus of the 220-kv. transmission line from Fifteen-Mile Falls.



Black indicates direct service, crosshatched indirect service. In Ipswich there is standby service.

Tenney properties involved in merger with New England Power group

New York's Cut Rates Go Into Operation

BRINGING A SAVING to consumers of $5,500,000—$3,100,000 to commercial users and $2,400,000 to domestic customers—the new rates of the New York Edison, Brooklyn Edison, United Electric Light & Power and New York & Queens Electric Light & Power companies went into effect on Thursday of this week with the formal approval of the New York Public Service Commission.

Although the new rates, which were explained in the ELECTRICAL WORLD for June 6 (page 1042), have been opposed by the Real Estate Board of New York as detrimental to the interests of landlords, no attempt to prevent their going into effect is expected, as the board, it is said, does not wish to stand in the way of a general rate reduction. An attempt to set aside the rates as far as they affect landlords will be made, however.

▼

In Idaho Also Constitutional Issue on Tax Arises

SUIT HAS BEEN FILED by the Utah Power & Light Company in the United States Court in Boise, Idaho, for an injunction to prevent collection of the tax of 0.5 mill per kilowatt-hour on all electric power generated in the state named. This tax was embodied in a law passed at the last session of the Idaho Legislature. The suit attacks the constitutionality of the act and of the call of Governor C. Ben Ross for the special session of the Legislature which enacted it. An interlocutory injunction and hearing before three federal judges at an early date is asked. Urgency is asserted because the law calls for a report by July 15 on power generated during June, upon which a tax is to be collected.

Making the same contention as that made in South Carolina by the Lexington Water & Power Company in the similar suit brought in that state (ELECTRICAL WORLD, June 20, page 1159), the plaintiff contends that the Idaho law is unconstitutional in that it interferes with interstate commerce by taxing a commodity which goes instantly into interstate commerce when generated. Other allegations are that the law deprives the company of the right to equal protection of the law through assessing a special tax upon it and that it provides a tax for one special group when it requires the company generating the power to return to irrigators and drainage users all the tax that has been collected on the power used by them in pumping projects.

Moreover, the tax is assailed as a double one in that the company is already paying a license tax and a property tax and is made subject to an income tax soon to go into effect. Levying of the tax would cost the power company approximately $120,000 a year, the contestant says, while very little of the power generated is used in Idaho, most of it going to Utah.

Governor C. Ben Ross declares that the state will make a vigorous fight to maintain the law. He believes it is constitutional, but should the courts hold otherwise, "there will," the Governor says, "be other ways found to require corporations that are enjoying the benefits of the God-given natural resources that belong to the people to pay their just proportion of taxes."

McGRAW-HILL PUBLISHING COMPANY'S NEW HOME

Erected at 330 West Forty-second Street, New York, with a frontage of 130 ft., running back 197 ft. to West Forty-first Street, this 33-story structure, with its great window area, will after Labor Day have as chief tenants the McGraw-Hill Publishing and associated and subsidiary companies, with the editorial and business offices of the ELECTRICAL WORLD *on the thirtieth floor.*

▼ ▼ ▼

Radio Commission Sustains R.C.A. Licenses

IN A THREE-TO-TWO decision Wednesday the Radio Commission held that Section 13 of the radio act did not bar the renewal of 1,403 licenses held by four subsidiaries of the Radio Corporation of America and that the section did not apply to the judgment of the Federal Court of Delaware holding the corporation guilty of violating the anti-monopoly law in the radio-tube case.

In accordance with the decision, all licenses were renewed to the National Broadcasting Company, the R. C. A. Victor Company, R. C. A. Communica-

tions, Inc., and the Radiomarine Corporation of America. The renewals had been held up pending the decision.

▼

Lee Stresses Field for Younger A.I.E.E. Men

TOPICS OF CURRENT INTEREST to electrical engineers in many branches of activity were comprised in the program of the summer convention of the American Institute of Electrical Engineers at Asheville, N. C., this week. Communication services for electric power systems, problems of interconnection, administration, electrical units and measuring devices, improvements in cables, automatic stations and progress in the development of machinery were major subjects. Next week the ELECTRICAL WORLD will report the sessions briefly and print some of the papers in abstract.

Announcement of the election of Charles E. Skinner as president for the coming year was made at the opening session. At this session also the award of the Lamme medal to William James Foster, retired designing engineer of the General Electric Company, for his contribution to the advancement of rotating electrical machinery was made.

President William S. Lee, the first Southerner to hold that office, reminded the members that it was 26 years since the 1905 meeting in Asheville, the only previous meeting held in Southern territory. He stressed the complete dependence of modern engineering enterprises upon a high degree of co-ordination in design, execution and operation. Assembly of minds must accompany assembly of men and materials to insure the desired effectiveness and economy of result, Mr. Lee said. The aim is rather a perfect product than a perfect design. In this field as well as in specialized technical channels there abound opportunities for skill, tact and ingenuity for the rising generation of engineers, the president insisted.

What attitude the Institute should take toward the question of registering or licensing engineers was discussed at a conference of section delegates. Though no formal recommendations were presented, the apparent consensus was that it had not been demonstrated that registration had subsequently benefited either the community or the engineer. Nevertheless, since half the states already have such laws, engineers should, it was held, encourage legislation which will eliminate the present inconsistency of reciprocity, give the public protection against incompetence and elevate the standing of the engineering profession.

A report that aroused especial interest came from D. W. Roper, who said that the Commonwealth Edison Company had successfully subjected to test-load cycles at 132 kv. cables which had insulation thicknesses commensurate with prevailing designs for 66 kv.

Friday was set aside for the inspection of the 135,000-kw. Waterville plant of the Carolina Power & Light Company, visits to fiber and rayon industries and scenic tours of Smoky Mountain territory. An all-day trip to Saluda Dam, near Columbia, S. C., was the order of the day for Saturday. Attendance reached 500.

HOW THEY BUILD LINES IN INDIA

East Indian labor employed by the W. T. Henleys Telegraph Works of London, to whom the picture is due, built this line in northwest India for the Quetta Electric Supply Company. One three-pole mast, 30 two-pole columns and 1,070 single poles, all of seamless steel tubing, were used. Note the frail ladder.

▼

Campaign Contributions by Coast Utilities Come Up

ORGANIZATION OF THE Idaho Power Company of Boise, a member of the Electric Bond & Share Company's group of utilities, was described in testimony on June 17 before the Federal Trade Commission, which, as reported last week (page 1159), examined the affairs of four of that company's associated firms in Western states. Edwin T. Harris, examiner for the commission, recited the financial history of the Idaho company, saying that the number of kilowatt-hours sold by the company decreased continuously from 1924 to 1928, although the total revenue for energy sold increased because of discontinuance of unprofitable flat-rate service. The rate of return on book values invested in fixed capital and on probable cost of fixed capital, according to the examiner, has been below a normal return, but dividends have been paid regularly since 1917. The company's subsidiary, the Nevada Power Company, had fixed capital investment of $267,207 paid in cash. The Nevada company has lost money in its operations almost continuously from its organization in 1917, the examiner said.

The matter of utility participation in political affairs was taken up, and it was brought out that prior to the elections held in November, 1930, in Oregon and Washington the Pacific Power & Light Company spent, "chiefly for pamphlets and advertising of relevant data and information," to oppose the Grange public utility and power district bills before the electorate in those states $2,796 in Oregon and $4,635 in Washington. The amount paid in Oregon was exclusive of $2,973 contributed by the company to funds collected by the Utility Taxpayers' Committee and the Washington contribution was exclusive of $2,865 contributed by the company to funds collected by a similar committee. Other expenditures of a similar nature in 1924 and 1926 were related.

The Electric Bond & Share Company charged construction fees of approximately $200,000 on the Fond du Lac hydro-electric development on the St. Louis River in Minnesota, which cost the Minnesota Power & Light Company, its subsidiary, $5,243,031, according to testimony given on June 18. The transaction was accomplished through the Phoenix Utility Company, a construction company operated by the Bond & Share, which set up an organization in Duluth to construct the plant, Leclaire Hoover, chief accountant examiner for the commission, testified. He said that the total New York engineering charges were $208,728 and the total construction fees $211,251, making a total of approximately $420,000, or slightly more than 8 per cent of the total construction work done for the Minnesota company.

After further testimony as to organization, properties, revenue and earnings of the Idaho Power Company, given by Judson C. Dickerman, engineer-examiner, adjournment was taken. A miscellaneous hearing was later set for Thursday, but only minor matters will be entered in the record before adjournment for the summer.

Eastern New Jersey and Jersey Central Merged

WITH THE APPROVAL of the New Jersey State Board of Public Utility Commissioners, plans to merge the Eastern New Jersey Power Company with the Jersey Central Power & Light Company, a subsidiary of the National Public Service Corporation, were announced on June 18 by Harry Reid, president of the Eastern subsidiary of the Middle West Utilities system.

The Jersey Central company is a direct subsidiary of the National Public Service Corporation. The Eastern New Jersey Power Company was purchased by it from the Utilities Power & Light Corporation last April (ELECTRICAL WORLD, May 2, page 794). The Jersey Central Power & Light is the purchasing company, and its name will be retained for the combined operating unit.

The consolidation of the two companies makes the Jersey Central Power & Light Company the second largest utility system in the State of New Jersey and one of the largest operating units in the Middle West Utilities system. Transmission lines in course of construction will link the two divisions into a single interconnected system, of which the chief centers of energy supply will be the two new steam generating stations at South Amboy and Sayreville, pertaining respectively to the Jersey Central and the Eastern New Jersey.

▼

Many Utilities Get Advertising Awards

PRIZE WINNERS in the annual competition of the Public Utilities Advertising Association for the best examples of advertising were announced last week at the association's annual convention in New York. Twenty-one awards were made for newspaper advertising by public utility companies in various sections of the country, and fifteen awards were made for advertising in other media, including car cards, posters, billboards, etc., according to Eric W. Swift of Chicago, the chairman of the association's "better copy" committee. Newspaper "copy" awards that went to light and power companies were:

Institutional Division.—First, Pacific Gas & Electric, San Francisco; second, North American Light & Power, Chicago; third, Puget Sound Power & Light, Seattle.

New-Business Division.—First, Commonwealth Edison, Chicago; second, Northern States Power, Minneapolis; third, Ohio Public Service, Cleveland.

Merchandise Division (electric and gas).—First, Philadelphia Company, Pittsburgh; second, People's Gas Light & Coke, Chicago; third, Public Service of Northern Illinois, Chicago.

Financial Division. — First, Northern States Power, Minneapolis; second, Ohio Edison, Akron; third, Utilities Power & Light Securities, Newport, R. I.

▼

EVEN BOXERS BENEFIT FROM SPECIAL LIGHTING

Dr. M. Luckiesh, General Electric lighting specialist, has entered the training ring with "Young" Stribling, but only to test the effect of the dual-purpose lighting—sixteen 500-watt "Mazda" lamps and one "Mazda Sunlight."

▼

Houston Lighting & Power Buys Galveston Electric

ACQUISITION BY THE Houston Lighting & Power Company of the electric light and power plant and other holdings of the Galveston Electric Company, already foreshadowed in the ELECTRICAL WORLD, has become an actuality, the Galveston City Commission having finally approved the transaction. The Galveston Electric Company was controlled by the Galveston-Houston Electric Company of Boston and under Stone & Webster management. The Houston company is a National Power & Light subsidiary under Electric Bond & Share Company supervision.

Bryan F. Williams, city attorney for the Texas coast city, was instructed to draw up ordinances governing rates and franchises. The City Commission stipulated that rates for residence lighting and power and for large industries shall be on an equality with rates now applying in Houston. For smaller industries, with monthly bills less than $270, the Galveston rates will be about 25 per cent higher than rates for similar industries in Houston. An annual saving of approximately $100,000 to Galveston consumers will be made under the new rates, according to the purchasing company's estimate.

▼

St. Lawrence Trustees Visit Massena Site

HEADED BY THE chairman, Frank P. Walsh, the five trustees of the New York State Power Authority, accompanied by Colonel Frederick Stuart Greene, State Commissioner of Public Works, and other engineers, visited Massena Point, the proposed site of the St. Lawrence hydro-electric development, on Monday of this week, going thence to visit the private Beauharnois project now under way in Quebec. The party surveyed the Long Sault Rapids from airplanes before motoring to Montreal. According to press reports, its members expect to convince the Canadian engineers who favor a two-stage development that the one-stage plan favored by Colonel Greene and the engineers who served with him as consultants when Massena Point was chosen as the favored site has superior advantages in cost, safety and as regards construction of the deep waterway that is bound up with the plans.

▼

Action for Removal of Commission Heard at Hartford

DECISION WAS RESERVED recently in the court at Hartford where two members of the Connecticut Public Utilities Commission went on trial in the forced suit of the State Attorney-General to oust them from office for neglect of duty in failing to order grade-crossing removals by railroads at the rate required by the statutes. Those on trial were Chairman Richard Higgins and Joseph W. Alsop. The other member of the commission originally affected was the late Charles C. Elwell.

Counsel for the commissioners presented evidence that was almost wholly of a documentary nature. The New York, New Haven & Hartford Railroad Company, prominent in the defense, was represented by counsel, who showed statistical reports to prove that during the period of alleged neglect the road

was not financially able to remove grade crossings at the required rate of eighteen a year.

As previously told in the ELECTRICAL WORLD, these proceedings were the result of persistent effort by Prof. Albert Levitt of Redding, Conn. The two commissioners testified that they believed rehabilitation of the New Haven railroad had been for several years past more important than the elimination of grade crossings. The statute under which action was brought was repealed at the last session of the General Assembly.

▼

Improvements from Excess Profits Not Capitalizable

BY AN ORDER denying an application of the Mondovi Telephone Company to capitalize its assets due to increased value through alleged appreciation the Wisconsin Railroad Commission recently set a precedent. The commission will hold a rate hearing on the theory that the company's earnings as shown in its statements indicate that it could give lower rates to its patrons with reasonable profit. The decision is regarded as one of the most important rendered by the commission and may prove of significance in the conduct of all utility finances in Wisconsin. The commission in refusing the application of the company for a stock dividend emphasizes:

1. That the company's reports for a rate-making basis will be held conclusive as to the value of the property and that the building up of plants out of excess profits reported as operating expenses but in reality used for improvements enhancing the value of the property will not be permitted.

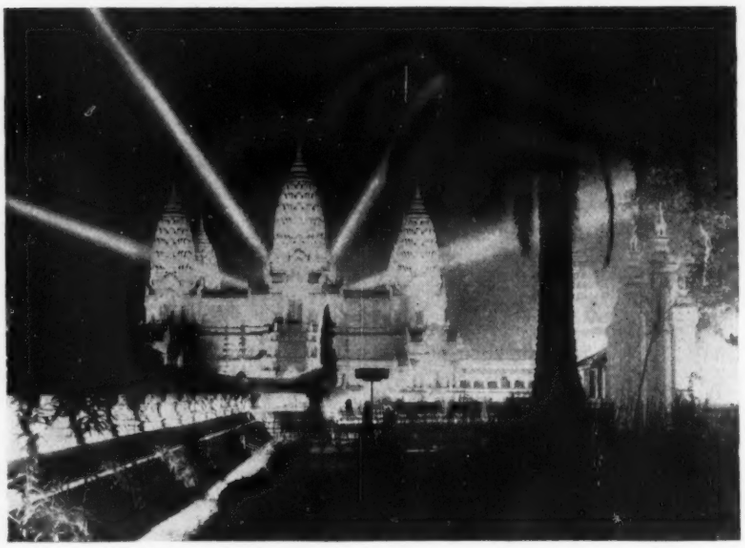
2. That appreciation and depreciation of assets due to construction will not be recognized as controlling rate-making factors because of the fluctuations in the values of materials.

One point emphasized in the opinion, written by Commissioner Lilienthal, is that public utilities will be held to the annual reports they make to the commission, to prevent a company from "building up its property through charges to operating expenses and then later seeking a fair return on this property which the consumers have already paid for out of rates."

Another feature of the opinion is the significance attached to the present decline in commodity prices. While prices were high, following the war, the utilities claimed rates upon reproduction costs to produce high valuations, it states. The opinion of the commission intimates that this policy, if turned around and applied against the utilities now that prices are receding, may prove embarrassing to the companies.

Discussing the annual reports by utilities to the commission, the decision says: "The commission believes that the regulatory usefulness of the annual report has not heretofore been adequately emphasized. We are of the opinion that the reporting public utilities may be estopped to deny the accuracy of these reports and the accuracy of their accounting procedure. The accounts and the annual reports of the public utilities subject to the commission's jurisdiction are representations as to property, revenues and expenses, and upon the basis of these representations the commission determines whether rates are reasonable and financial practices consistent with the public interest."

"TEMPLE OF ANGOR" AT PARIS COLONIAL EXHIBITION



By electricity's help this reproduction of an Oriental temple, transformed to an industrial showplace, became one of the chief attractions of the exposition by night as well as by day.

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Canadians Interested in Merchandising Problems

TWO HUNDRED AND EIGHTY delegates and their wives from all parts of Canada gathered at the famous Banff Springs resort in the Canadian Rockies on June 16 to 18 for the forty-first annual convention of the Canadian Electrical Association. Opening sessions were mainly taken up with the address of the President, George R. Atchison, Southern Canada Power Company, Montreal, and reports of committees. At dinner J. E. Brownlee, Premier of Alberta, welcomed the delegates.

Papers at the business sessions included one on "Electrons at Work and at Play," by L. W. Chubb and Dr. Phillips Thomas, both of Westinghouse, and one on oil circuit breakers by E. B. Merriman, General Electric. The merchandising of electrical appliances was dealt with both by J. K. Wilson, chairman of the Merchandising Bureau, and A. S. Edgar, representing the National Electric Light Association.

Mr. Atchison was re-elected president. J. S. Parker, Gatineau Electric Light Company, Ottawa; Alex D. Ross, Canadian Niagara Power Company, and John Morse, Shawinigan Water & Power Company, Montreal, were made vice-presidents.

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San Joaquin Valley Users Organize for Cheap Power

ORGANIZATION OF the San Joaquin Valley Powers Users' Association, now under way, with headquarters in Fresno, Calif., is designed "to encourage better and more economical methods of securing power for agricultural purposes and make such investigations and studies as may be necessary to aid and assist the various districts in the San Joaquin Valley counties to obtain power at the lowest possible costs." The territory covered includes the counties of Stanislaus, Merced, Madera, Fresno, Kings, Tulare and Kern. Three directors are to be elected from each county.

This movement is regarded as the outgrowth of the recent agitation in the San Joaquin Valley for a reduction in power rates. As reported at the time, the California Railroad Commission on April 8 ordered a 20 per cent reduction in the rates of the San Joaquin Light & Power Corporation, to become effective May 1 and continue till August 31. A further hearing is to be held in the fall.

Scattered Happenings in the Electrical Sphere

UNITED STATES

President Renominates C. L. Draper

Claude L. Draper of Wyoming has been reappointed by President Hoover to be a member of the Federal Power Commission for the five-year term expiring June 22, 1936. Mr. Draper, originally appointed for a year, has served but a half year, the commission not having been sworn in until six months after the passage of the law by which it was created. His reappointment must be approved by the Senate when it meets.

Indiana Commission's Municipal Policy

Non-interference in the internal affairs of all municipally owned utilities in Indiana was laid down last week as the policy of the Indiana Public Service Commission. The ruling said the commission has authority to require these utilities to provide adequate service, but it has no authority to determine how the service shall be provided. The policy was enunciated in denying a petition of a group of manufacturers of Richmond, Ind., who asked an order requiring the municipal light plant to provide standby service by purchasing power from an outside utility. Previously the commission had assumed considerable latitude in dealing with municipal utilities.

Michigan Association Meets Next Week

Mackinac Island will again be the meeting place for the Michigan Electric Light Association next week. On Tuesday, June 30, President D. W. Hayes and James V. Oxtoby, Detroit Edison Company counsel, will address the convention. On the following day three papers on the development of the domestic load will be read by C. R. Landrigan, Detroit Edison; Sam Stites, Consumers Power, and C. L. Bougher, Michigan Electric Power Company, respectively.

Missouri May Tax Submerged Land

Lands submerged because of a hydro-electric development are subject to taxation in Missouri, the Attorney-General's office of that state has ruled, citing the Susquehanna Power Company case decided by the Supreme Court of the United States. The question arose in Missouri in connection with the Bagnell Dam on the Osage River.

"Jacona" Now at Portsmouth, N. H.

Leaving Bucksport, Me., where until a few weeks ago it had been supplying energy to a large paper mill, the Insull company power boat *Jacona* recently proceeded to Portsmouth, N. H., and anchored in the Piscataqui River about 1½ miles upstream from the generating station of the New Hampshire Gas & Electric Company there. Operated by the Public Service Company of New Hampshire, the vessel's 11,000-volt output is stepped up to 33,000 volts for transmission to Portsmouth and to 66,000 volts for transmission over the new line to Dover. The New Hampshire Gas & Electric says that it is more economical at this time to purchase energy from the *Jacona* than to extend its own plant facilities.

Tillamook, Ore., Wants Utility District

In order to protect the water-power supply of a proposed public utility district, application has been made to the Oregon Hydro-Electric Commission for a preliminary permit to appropriate 6,000 sec.-ft. from Trask River and for the construction of three reservoirs to permit the development of 45,000 hp. Applicants are W. H. Leach, O. A. Schultz and James Williams, all of Tillamook, and petitions for the formation of the district are being circulated throughout the county of the same name. The Mountain States Power Company now supplies the territory.

Carolina Hardware Men on Merchandising

A resolution adopted by the Hardware Association of the Carolinas, meeting at Greensboro, N. C., recently, urged that the public service commissions of the two states investigate utility merchandising practices to the end that the sale of appliances by utility companies be segregated from utility service functions and that all expense of such merchandising be excluded from general operating costs, the sale of appliances being made to pay its own way.

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Coming Meetings

Michigan Electric Light Association—Grand Hotel, Mackinac Island, June 29-July 1. Herbert Silvester, 401 South Street, Ann Arbor, Mich.

Camp Co-operation XI — Association Island, Henderson Harbor, N. Y., July 27-31. Society for Electrical Development, 420 Lexington Avenue, New York.

American Institute of Electrical Engineers—Pacific Coast Division, Lake Tahoe, Calif., Aug. 25-28. F. L. Hutchinson, 33 W. 39th St., New York.

Rocky Mountain Division, N.E.L.A.—Stanley Hotel, Estes Park, Colo., Sept. 2-4. G. E. Lewis, 367 Gas & Electric Bldg., Denver.

Electrochemical Society — Hotel Utah, Salt Lake City, Sept. 2-5. C. G. Fink, Columbia University, New York.

Pennsylvania Electric Association — Bedford Springs Hotel, Bedford Springs, Pa., Sept. 9-11. H. A. Buch, Telegraph Bldg., Harrisburg, Pa.

Empire State Gas and Electric Association—The Sagamore, Bolton Landing, Lake George, N. Y., Sept. 10-11. C. H. B. Chapin, Grand Central Terminal, New York.

American Welding Society — Copley-Plaza Hotel, Boston, Sept. 21-25. M. M. Kelly, 33 W. 39th St., New York.

New England Division, N.E.L.A.—Poland Springs House, South Poland, Me., Sept. 28-30. Miss O. A. Bursiel, 20 Providence St., Boston.

For a Single Patent Appeals Court

Establishment of a single court of patent appeals is proposed by the American Engineering Council in a report of its patents committee, of which Edwin J. Prindle, former president of the New York Patent Law Association, is chairman. Such a court, it is declared, would stimulate inventing and would protect both patentee and public from enormous waste. The National Association of Manufacturers is said to have approved the proposal.

Economic Conference for Engineers

An economic conference for engineers will be held from August 30 to September 7, inclusive, at the Stevens Institute engineering camp near Johnsonburg, N. J. The Stevens alumni and the Columbia University engineering alumni will jointly sponsor the gathering, to which graduates of other colleges and the younger members of the national engineering societies will be welcomed. Morning and evening sessions will be held.

Cascade Rapids Project Is Up

Investigation by the United States district engineer stationed at Portland, Ore., of the Columbia River Power Company's fifteen-million-dollar hydro-electric power project on the Columbia River at Cascade Rapids is proceeding, and a decision on the application for a permit may be rendered this summer by the Federal Power Commission. Present plans call for development of 235,000 hp. Water would be diverted into a series of canals by a wing dam 1,500 ft. long and 15 ft. high.

ABROAD

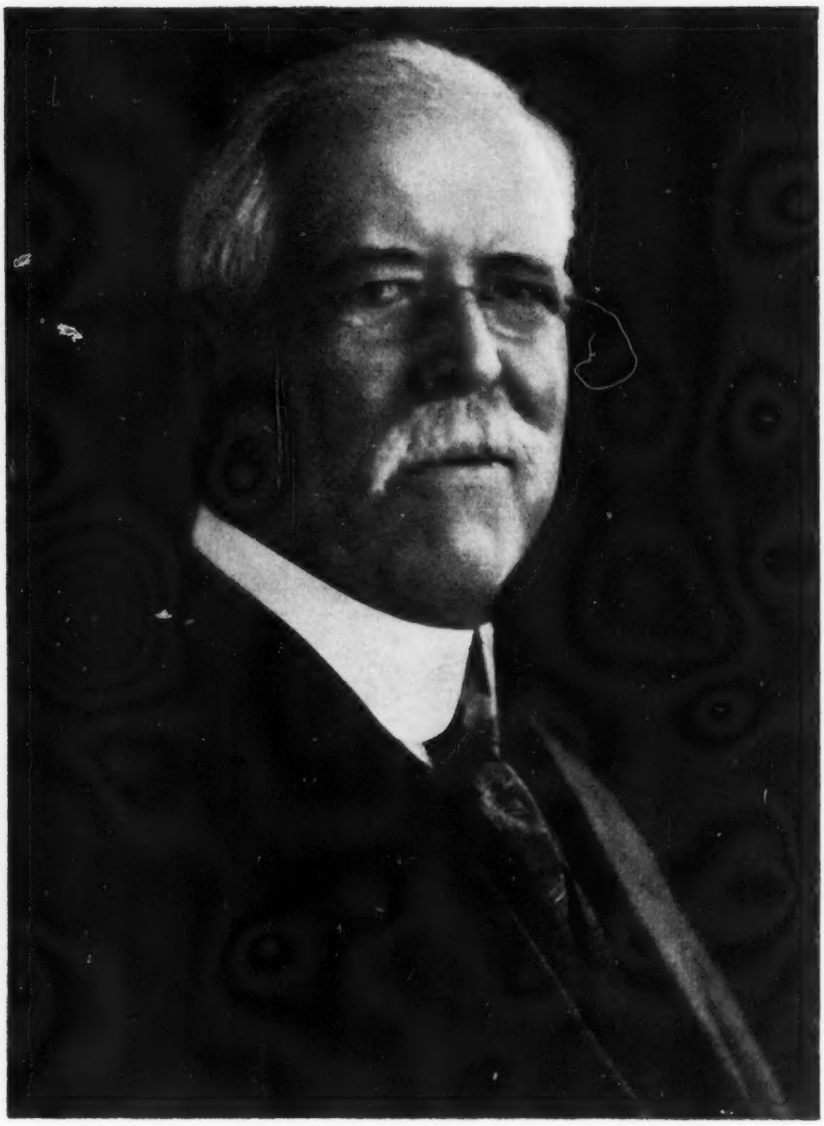
Electrical Growth in Mexico

An increase of more than 100,000,000 pesos ($50,000,000) in the total investments in electric power and light plants and transmission lines has taken place in Mexico during the last five years, according to figures made public by the statistical bureau of the Mexican government. The grand total of investments in the electrical industry in that country is placed at approximately $145,024,626. Most of the new power projects are in the states of Jalisco, Michoacan and Chihuahua. Nearly all the capital invested in these plants came from foreign sources, most of it American, with Canadian interests second.

London to Light Up

Buckingham Palace will be illuminated by powerful floodlamps during the International Illumination Congress in September next, when an effort will be put forth to make London the most brilliantly lighted capital in Europe. It is hoped to illuminate the riverside, the Thames bridges and many historic and beautiful buildings, including the Westminster clock tower.

Samuel T. Bodine



AMONG the real veterans in the public utility field stands Samuel T. Bodine, chairman of the board of directors of the United Gas Improvement Company of Philadelphia. In his nearly fifty years of service with this organization Mr. Bodine's influence, it goes without saying, has been very potent in shaping the development of the company, of which he is the oldest executive in point of service. His career has been that of the well-balanced executive, shunning extremes alike of radicalism and conservatism and steadily building a great property without sensational episodes or frequent performances in the spotlight. His trend of mind was exemplified characteristically in 1925 by the establishment of the Samuel T. Bodine meritorious service award to U.G.I. employees for "extraordinary effort, without regard to self, toward maintaining uninterrupted service, or toward restoring interrupted service, or in some manner indicating exceptional fidelity to the public interests."

Mr. Bodine is a native of Philadelphia, where he was born in 1854 and where he was graduated from the University of Pennsylvania in 1873. In 1882 Mr. Bodine, who had been in the employ of Peter Wright & Sons, operators of two transatlantic steamship lines, became associated with a group of men who were planning to organize the U.G.I. Company to promote the sale of Lowe carbureted water-gas apparatus. When the organization was completed he became bookkeeper and general clerk, and soon thereafter he was elected secretary-treasurer. Subsequently he successively held the posts of general manager, vice-president and president from 1911 to 1926. In the year last named he was elected to the chairmanship of the board, and he has since then filled this office continuously.

Besides his responsibilities with the U.G.I. and important subsidiaries of that company, Mr. Bodine is a director of the Fidelity-Philadelphia Trust Company, the Philadelphia National Bank and the Pennsylvania Company for Insurance on Lives and Granting Annuities.

EDITORIALS

L.W.W.MORROW
Editor

The valley may rise to the hill

CONCEPTIONS of the fundamental principles of rate making in the electric utility business are classic. They stem back to the analyses of Hopkinson and Wright, however much their present-day expressions are hung about like Christmas trees with modern ideas and expedients. Those bases of rates, enunciated so early in the history of the art, must remain the lowermost and the strongest stones in all electric rate structures.

On these old stones, however, has sprung up an ivy that possibly may greatly harm the structure. The general time coincidence of electric loads makes the major burdens on supply systems fall within definite hours, the hours when human beings are awake and going about their various occupations. It was natural, then, when collection for service rendered was considered, that the fixed costs for investment and other continuous elements should be mostly levied on the most numerous class of customers—a class that for long remained the only one. This attitude of mind favored the thought that load served at a different time in the twenty-four hours of the day, when the system burden was very low, need not be saddled with fixed costs to any great degree and might be taken on at a price to allow a profit on the operating increment of cost only.

Barring revolutionary discoveries and inventions, the prospects of a system load curve without hills and valleys are still in the future and remain a pleasant theme for speculation. But off-peak rates may become embarrassing before the advent of a level load curve.

The off-peak load need only rise to respectable proportions and supply a reasonable number of customers for those other customers who are carrying the larger part of the fixed charges to become restive and begin to talk about discriminatory rates. Such off-peak load possibilities are already in sight. Just as the idea of "dump power" is shading now into full eclipse, so must the idea of "off-peak" rates merge into the limbo of forgotten things eventually. Such rates should be used with care lest they become a handicap and not an asset.

More interpretation of financial statements

FINANCIAL statements issued by utility companies have improved greatly in intelligibility, but there are still many that challenge the ingenuity of any one not schooled in the intricacies of accounting. Standardization of accounts with its unquestioned value for purposes of comparison may lead to public misunderstanding or misinterpretation. Broad classifications not thoroughly understood lead to exaggerated ideas of profits —to charges of unduly large earnings on common stock, unduly high service rates, watered stock and the rest.

The statements of most representative utilities for 1930, when interpreted, show the results of increasingly able management, of keen planning and foresight, and indicate a very narrow margin of profit to the common-stock owners considering the risk involved in the general uncertainty of business. But these facts are not readily understood by the public. Even where the information is imparted intelligibly, it often is presented only to stockholders, remarkable though it is that there should still be an almost universal assumption that the buyer of service has no interest in the operations of a utility unless he happens also to be a stockholder.

Certain banks have reaped valuable advertising and good will from simplifying their statements. The utilities, engaged in the public service, have infinitely more to gain from having their

public familiar with their financial operations and thus equipped to develop a sympathetic understanding of problems obviously mutual. Could there be any more potent check upon the activities of political trouble makers, whose greatest asset is the charge of excess profits and excess financing?

Sunrise as well as lightning figures in transmission interruptions

LIGHTNING as a menace is well on its way toward subjugation as far as power transmission is concerned, but other disturbances remain to be mastered in the effort to give service with never an unforeseen interruption. Messrs. George and Brownlee of Tennessee have been giving attention to interruptions not caused by lightning and have discovered the striking fact that 70 per cent occur at or near sunrise. They submit no explanation but do point out that there must be a ruling cause, since pure possibility of the congregation of interruptions at this hour would be as slim as the chance of survival of the proverbial snowball.

It is evident that unless the trouble can be attributed to birds or to purely thermal phenomena it must be associated with the effects of the sun's rays at a time of day when fog and dew are likely to be prevalent. Admittedly, fog and dew deposits on insulators are quite different from the artificial rain used in wet breakdown tests. What reason have we for believing that a film may not behave in a totally different manner from a deposit of discrete globules separated by dry surface and un-ionized air? Why may not the sun's rays effect the ionization of the air to an extent that will produce the corona that precedes breakdown? What about the ozone and nitrification that attend this process?

Radio engineers have long held to the belief that there is a definite correlation between reception and the moon's phases. In this case the effect appears to be rather electrostatic than due to the actinic or photo-electric possibility attributed to the sun. It looks, therefore, as if power engineers would have to give as much attention some day to phenomena that happen when the sun emerges from below the horizon or from behind a cloud as they have been giving to the flashes that come from the cloud. Likewise the research laboratories have a challenge confronting them to design an insulator that will stand a few thousand volts when the sun shines on them as readily as they withstand a few million volts of impulsive shock from a cloud that obscures that sun.

The ultraviolet situation

MORE has been said and written recently about ultraviolet radiation than about any other branch of lighting, and yet very little definite knowledge concerning it can be found in existing literature. Advertisements proclaim the great benefits of the life-giving sunrays, and yet when it is definitely asked in what respect ultraviolet radiation benefits the human body the only definite answer so far given is that the rays prevent and cure rickets and are beneficial to chickens confined to henhouses in the winter time.

At a recent meeting of the Illuminating Engineering Society the versatile and competent Norman Macbeth observed that he was neither a chicken nor a child suffering from rickets and desired to know in what respect ultraviolet radiation could benefit him. He also brought out the fact that the medical profession is quite noncommittal, if not negative, on the subject and is not certain that ultraviolet radiation improperly applied would not cause permanent injury to human tissues and perhaps do a great deal of harm to those suffering from hardening of the arteries. The proponents of ultraviolet quite promptly and correctly replied that the matter of treatment must be left in the hands of the medical profession. The fact remains, however, that illuminating engineers are actively advocating the wide use of ultraviolet radiation, even going so far as to recommend it for purposes of general illumination.

Mr. Macbeth's warning that they must be more conservative in their recommendations or run the danger of being listed among the quacks is very timely. It is well to place every possibly curative means in the hands of biologists and men of medicine to experiment with, but it is for them and for them alone to decide definitely what is helpful and what is harmful to the human body and when and how anything resembling a treatment should be used. Human life is too precious for laymen to prescribe remedies for physical ills.

Engineers must awaken from lethargy about licensing

DURING the legislative season now ended in all save a few of the states engineer licensing bills were under consideration in several commonwealths. In some such bills were passed; in others the engineers in general were indifferent and the legislators failed to heed the importunities of the minorities that urged the bills. This indifference should not be allowed to persist. Engineers, and especially electrical engineers, should inform themselves of the advantages and disadvantages of a licensing system. Otherwise they are likely to find the engineering profession relegated to an inferior status from which it could never emerge to logical parity with law, medicine and the ministry.

The ideal aim of licensing would be to exclude inexperienced persons from designing and installing structures and systems in which public safety is involved. The pressure, however, for licensing legislation has often come not from the public but from organized minorities whose motives have often been subversive of the interests of engineers generally. In certain instances architects have brought about the passage of bills which prevent engineers from filing plans for buildings and structures, even those of such a nature that few architects would desire to undertake more than the esthetic elements of the design. In such cases it is the structural engineers who are most concerned with the menace of legislation which will render them subservient to members of another profession.

It would, none the less, be extremely unfortunate for the rest of the professional engineering world to have legal distinctions drawn which would license only those engineers who design structures involving hazards of travel and habitation. If the inevitable licensing movement is to confer ultimately upon all engineers the professional distinction which they have a right to claim, then all engineers must first agree upon an acceptable definition of their engineering function and after that they must work in concert to see that legislation gives the public protection against incompetency and imposes on the engineers an obligation to meet a minimum qualification.

The problem is not easy, but its complexity should not be used as a shield by those who feel that licensing confers no immediate benefits on either the public or the engineer. The benefits lie in the decade ahead.

Excess varieties still burden industry

BOILED down to maximum economic concentration, standardization in engineering development means the elimination of excess varieties. Manufacturers are for it and operators of plants should be enthusiastic supporters of the process. Endless debate could be held over the definition of what an excess variety in electrical equipment design is, but the fundamental principle cannot be safely overlooked in future engineering. In a word, it is an economic crime to demand needless variety in apparatus built for utilitarian service, and the ultimate test is whether existing products can be counted upon to meet the problem in hand well enough to satisfy the reasonable requirements of leading professional and business judgment.

Departure from proved standards can no longer be justified on the grounds of individual pride in having something different or on the basis of technical whims. Only where the benefits of leaving the broad highway of swift and efficient manufacture and distribution are clearly defined and of due weight should there be a change of route to pioneering pathways. Research, development and the cultivation of new markets will go on because the variety of human necessities is a dynamic movement and a challenge; but let there be an end of trivial modifications of first-class material to please somebody's ego.

There is room for diverse talents to find expression in satisfying both routine and special requirements. Routine needs demanding standard designs and construction will always employ the majority of men, and the elimination of excess varieties can never stop progress warranted by the creation of new necessities and opportunities. The final justification of the engineer's cost to society lies in his capacity to make the choice between the old and the new in equipment, materials and methods, but today the presumption favors standardization, since by giving it weight often denied in the past costs can be reduced all around and earnings increased with resulting benefits to research as well as to consumers and investors.

Outdoor Features Simplify

STRUCTURAL simplicity has been obtained to a striking degree in the new hydro-electric development of the Union Electric Light & Power Company on the Osage River near Bagnell, Mo., by utilizing an outdoor type of station and generating unit design, paralleling generators on the low-tension bus only and omitting high-tension buses. Ultimately this plant will contain eight units aggregating 220,000 kva. Energy will be transmitted at 132 kv. to St. Louis by three initial circuits, one being carried on wood pole H-frame construction to the Page Avenue substation in that city and the others connecting through Rivermines on steel towers with wooden crossarms. Back of the dam at Osage has been created the fourth largest artificial lake in the country. The Stone & Webster Engineering Corporation is the designing and construction engineer for this development.

The most economical limit of reservoir development established a storage area of 95 square miles in pondage. Above the dam site the river drains 14,000 square miles. With a 30-ft. drawdown, about 1,200,000 acre-ft. of storage will be available, which will equalize the river flow through a record dry year. The maximum and minimum recorded flows are 110,000 and 324 sec.ft. respectively, with an average of 10,500 sec.ft. for a thirteen-year period. From this development it is expected to obtain from 150,000,000 kw.-hr. in a dry year to 800,000,000 in a wet one, with an average of about 425,000,000. The operating head will range between 68 and 106 ft., the tailwater level varying by about 38 ft. according to the flow.

Peak-load development with large equalizing storage.

Electrification of Osage River supplements Keokuk plant on the Mississippi.

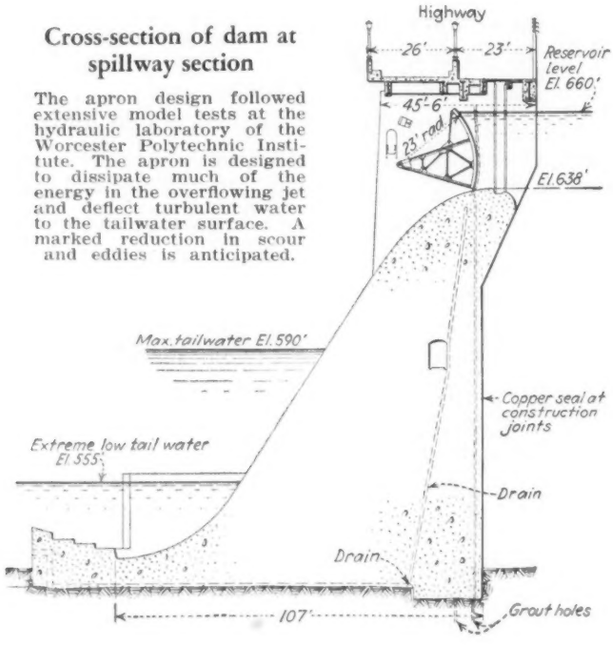
Major industrial load tapped en route to St. Louis.

Outdoor type generating units protected by removable housings.

Transmission line breakers and high-tension buses omitted.

Cross-section of dam at spillway section

The apron design followed extensive model tests at the hydraulic laboratory of the Worcester Polytechnic Institute. The apron is designed to dissipate much of the energy in the overflowing jet and deflect turbulent water to the tailwater surface. A marked reduction in scour and eddies is anticipated.



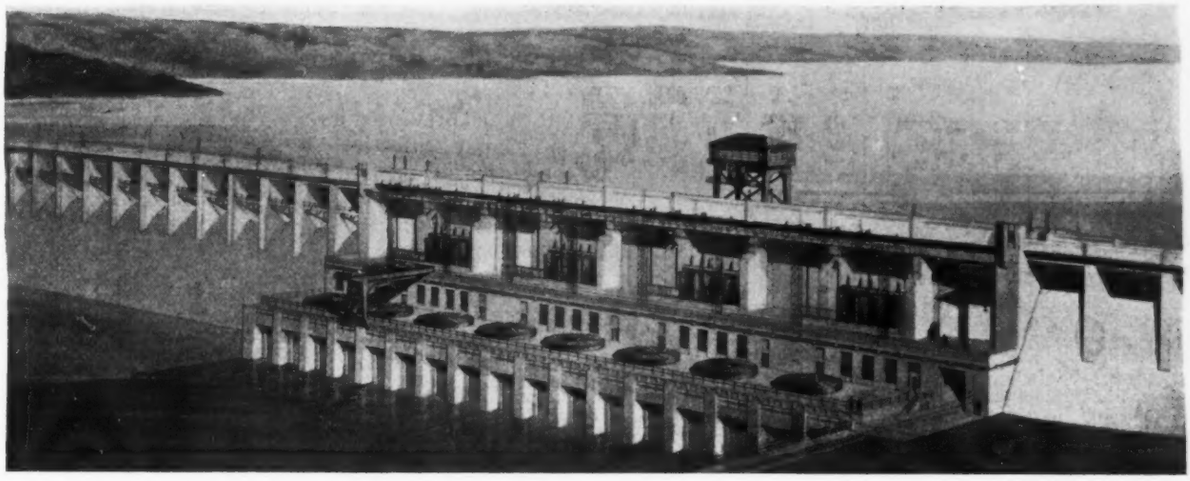
Although the Osage development is about 140 miles from St. Louis, it was considered, with the installation of a spare transmission circuit, to be of primary power rating. Stability studies indicated that 170,000 kw. could be satisfactorily transmitted with the proposed lines and the Osage station was designed on this basis. About 150,000,000 kw.-hr. per year is to be purchased by the St. Joseph Lead Company at Rivermines, en route to St. Louis.

A concrete dam 2,543 ft. long and 148 ft. in maximum height, with gravity section, impounds the water, and the generating station, 511 ft. long, is located in the river channel section of the dam. The spillway has a capacity of 162,000 sec.ft. In the spillway section are twelve tainter gates, each 34 ft. long and 23 ft. high, with 6-ft. piers intervening which support the gate trunnions and a highway and operating deck above. The operating deck is upstream from the highway and provides working space for two 70-ton gantry cranes for operating the tainter gates, fixed roller type headgates and to place or remove trash rack sections and stop logs. Compressed air will be used to prevent accumulation of ice pressure against the tainter gates.

The power station section is designed for the installation of eight main and two station service units. Initially there will be six main and two station service units. The headworks section acts essentially as a gravity dam, and the upper portion, including intakes, racks and gates, is of reinforced concrete. Plate-lined steel penstocks lead through the headworks to the scroll cases of the main units. The electrical bay of the station is built over the penstocks between the generators and the headworks wall. Above the electrical bay are the step-up transformers and take-off structure for the outgoing lines, line disconnecting switches, carrier coupling condensers and lightning arrester equipment.

Each main generating unit consists of a 27,500-kw.

Osage River Hydro Design



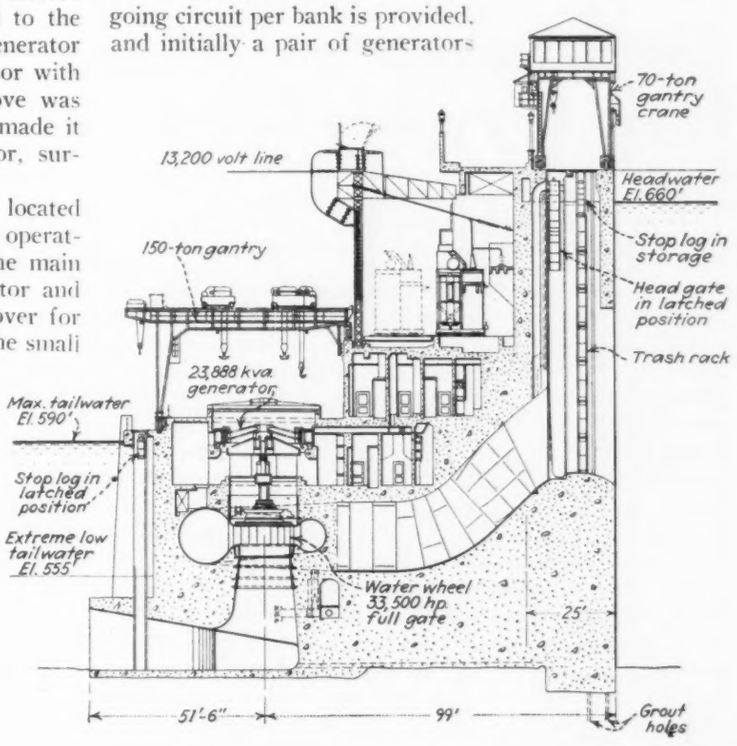
umbrella type Westinghouse generator delivering three-phase, 60-cycle energy at 13,800 volts, direct driven by an Allis-Chalmers vertical shaft, Francis type turbine of 33,500 hp. full gate rating at 90 ft. net head, running 112.5 r.p.m. and designed to give 30,000 hp. at best gate. Each generator has a closed water-cooled air circulating system.

Superstructure over generators omitted

The building superstructure over the generator room was omitted and the station crane is of the outdoor type with one gantry leg, the other crane rail being carried by the electrical bay wall. All ordinary access to the generators will be by the wheel pit. Motor-generator exciters are mounted on the main waterwheel floor with other auxiliary equipment. The next floor above was raised a few feet above floodwater level, which made it feasible to locate the generators below this floor, surmounting them by metal housings.

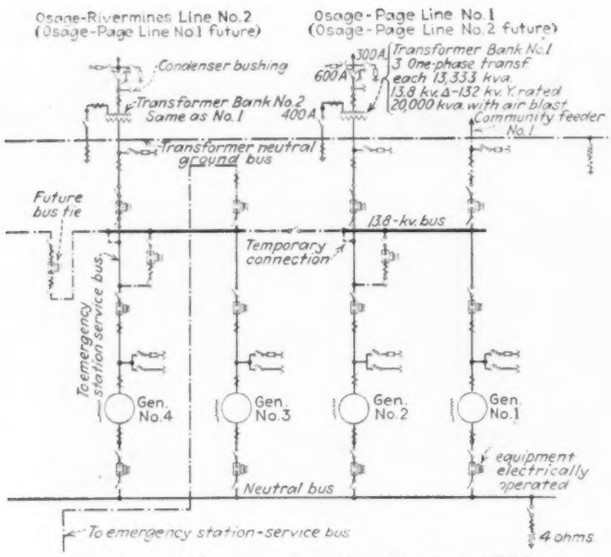
The metal housings above the generators are located high enough so that by using jacks and the crane operating through a smaller cover in the center of the main housing the rotor can be lifted clear of the stator and supported on a shaft extension under the main cover for normal repairs. In carrying out this procedure the small cover is first removed from the housing, the shaft extension is bolted to the main shaft and the rotor is then jacked free of the main shaft and raised by the crane about 6 ft. A ring key is put around the shaft extension under the rotor and the rotor let down upon it. Full access to rotor and stator is thus obtained. It is necessary to remove the main housing only in case of withdrawing the rotor entirely or of dismantling the waterwheel.

At present three General Electric 13,800-132,000-volt transformer banks will be installed, each consisting of three single-phase units rated at 40,000 kva. per bank and at 60,000 kva. with air-blast cooling. A fourth bank will be added later. The outgoing circuits will be connected to the transformers through airbreak disconnecting switches only, without oil breakers or 132-kv. buses. One outgoing circuit per bank is provided, and initially a pair of generators



Semi-outdoor power house economizes materials

Outdoor, umbrella type generators rendered quickly accessible, as are the driving turbines through removable housings and a gantry crane installation. Six units will be installed initially.



Simple switching and sectionalizing facilities

will be connected through 13.8-kv. oil circuit breakers to one transformer bank.

Later a sectionalized 13.8-kv. station bus will be installed, to which four of the eight generating units will be connected through their respective oil circuit breakers. The connections for the four remaining generator units will be arranged to form a generator-transformer-line unit, with an oil breaker connection to the 13.8-kv. bus interposed between the generator and transformer oil circuit breakers.

Major station service auxiliaries will be energized from a 2,400-volt sectionalized single bus supplied with energy from two 3,000-kva. waterwheel-driven generators.

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Correct Generator Synchronizing Insured by Auxiliary Control

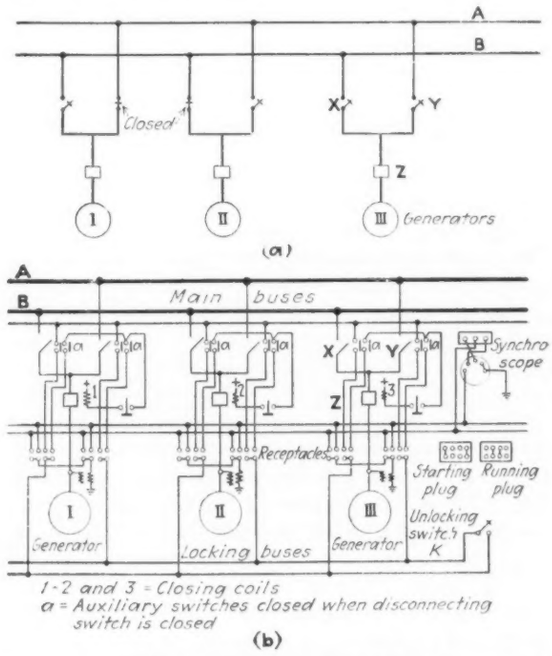
By JOHN AUCHINCLOSS

Switchgear Department,
General Electric Company, Philadelphia, Pa.

A certain hazard always surrounds the operation of synchronizing on double-bus systems where bus selection is accomplished by means of air-break disconnecting switches. If the wrong selector is closed it is possible inadvertently to parallel a generator or line with another with which it has not been previously synchronized.

For example, in (a) of the accompanying figure suppose generator I is running on bus *A*, generator II on bus *B*, and it is desired to synchronize generator III with generator II on bus *B*. The usual procedure would be to close disconnecting switch *X* on bus *B* and after synchronizing generator III with generator II by means of the synchroscope to close breaker *Z*, thereby paralleling generators II and III on bus *B*. So far all would have been well, but suppose that instead of closing disconnecting switch *X* the operator had inadvertently closed disconnecting switch *Y* and then proceeded to go through the operation of synchronizing generator III with generator II. At the moment of synchronism between generators II and III he closes switch *Z*. Obviously the immediate result is the paralleling of generators I and III through bus *A*, and since generator III had been synchronized with generator II but not with generator I, the gravity of the possible consequence is immediately apparent. This is not merely an imaginary case, for it is known to have occurred in a number of instances, and only extreme vigilance on the part of operators in general is responsible for the good fortune which has prevented its occurrence in a great many more.

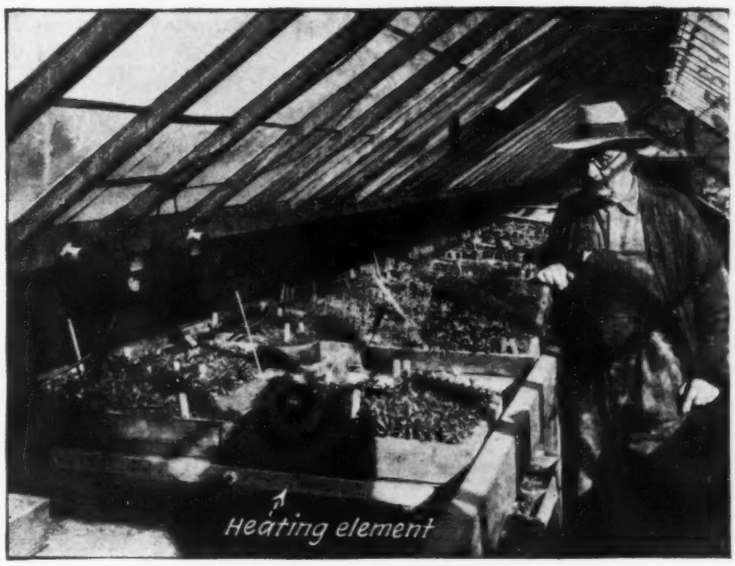
To guard effectively against such disastrous mishaps the writer has devised a scheme of control for electrically operated breakers which is shown in sufficient detail in (b) to illustrate the safety features which it incorporates. An understanding of these features can readily be gained by following step by step the operation already described under (a), when it will be found that if the same error is committed its consequences will be entirely prevented by breaker *Z*, which cannot be closed because of the gap in its closing control circuit left by the auxiliary switches at the selectors. A study of the method will disclose that by means of the unlocking switch *K*, which may be under the control of the chief operator or may take the form of an auxiliary switch on the bus tie breaker, if one is provided, the safety features may be temporarily withdrawn in order to transfer generators from one bus to the other. The scheme also lends itself particularly well to those double bus arrangements in which either bus may be used alternately as a spare bus, or where it is desired to isolate an entire bus for purposes of inspection. It might be added that the synchronizing plugs are arranged in such a way that no wrong connection can follow their insertion in an inverted position.



Auxiliary switches on generator breaker control prevent faulty closing

(a) When connecting generator III to machine I or II synchronism with the right machine must be insured. (b) Auxiliary switches prevent closing of machine breaker until conditions are correct.

2 to 3 Kw.-Hr. per Day Heats Plant Beds



200-watt element heats four plant boxes
Cost $9; consumption 2 to 3 kw.-hr. per day.

Gardeners and florists are enthusiastic over a small hotbed heater developed with the assistance of the rural service department of the Portland (Ore.) General Electric Company. These little devices are proving a good load builder on rural lines and very satisfactory for plant propagation. Metal trays 30x40 in. in size, having a 200-watt nichrome heating element thermostatically controlled, serve as a heating medium for four "flats" or plant boxes. Connection is made to any lamp socket and several trays are connected to the same thermostat if like temperatures are desired in all boxes. Check meters show each tray consumes from 2 to 3 kw.-hr. per day. The price of the equipment is only $9 per heater.

By maintaining temperatures from 60 to 70 deg. one florist was able to root 95 per cent of his plants in fifteen days, whereas under former methods only 40 per cent rooted in three months.

For Better Public Relations

To improve the public relations situation locally and nationally, I would suggest that we——

1. Plan to study the public relations question just as carefully in the next several years as the technical question has been studied in the past few years.

2. Apply more of the external and less of the internal viewpoint with respect to public good will.

3. Appreciate that confidence brings good public relations and that performance rather than promises brings confidence.

4. Develop the best possible solutions for the public issues confronting our industry.

5. Remember that the two chief points in the average customer's mind concerning our industry are pocketbook (rates) and convenience (service).

6. Continue to develop technical improvements and commercial activities so that rates and service may be favorably affected as often and as much as possible.

7. Strive to ascertain and understand the rank and file of public opinion in our various company territories.

8. Never maintain the attitude that we are always right, but be open-minded toward all reasonable criticism.

9. Revise company policies when, as and if desirable so that public convenience may best be served at all times.

10. Explain to people from their viewpoint those economic fundamentals of the industry which critics are distorting.

11. Publicly answer false charges when made by critics of national reputation.

12. Never overstate the facts in connection with sales activities, whether of service, appliances or securities.

13. Show people by the written word, by the spoken word and by demonstration the variety of services which electricity performs and can perform for them in the home, the office, the store, the factory and on the farm.

14. Sell the idea that public good will concerns every member of an organization and not just the public relations department alone.

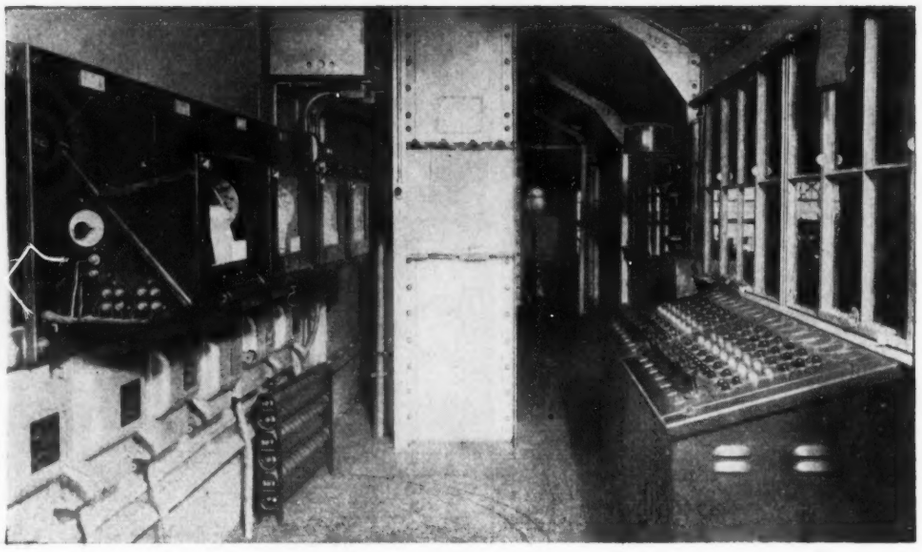
15. Conduct training programs so that employees can handle questions and complaints as well as the mechanics of their daily work.

16. Offer customers the opportunity of becoming partners in our industry through employee sales of preferred stock.

17. Keep investors regularly and clearly informed concerning the status and progress of our companies.

18. Conduct carefully planned public relations programs to increase and maintain public understanding and good will.

HARRY REID,
Chairman N.E.L.A.
Public Relations National Section.



Room from which operator controls fourteen soaking pits. On the right is the control desk with lamps. Indicating pyrometer just above far end of desk. On the left recording pyrometers with sign flashing current source above. Temperature controllers are behind the column.

Operation of Fourteen Soaking Pits Controlled by One Man

By KIRTLAND MARSH

Charging Furnace Division,
Central Mechanical Engineering Department,
The Aluminum Company of America, Pittsburgh, Pa.

ONE operator, located in a control room at the Massena plant of the Aluminum Company of America, has charge of the temperatures in fourteen electrically heated soaking pits and their operating cycle and, by means of a signal light system, directs the mill crane operator and the soaking-pit gantry crane operator in charging and discharging the pits.

The control room is located above and to one side of the line of pits, from which position the operator can observe all the pits, the gantry crane, the mill crane, the ingot storage space and the blooming mill. All automatic temperature control instruments and recording and indicating pyrometers are located in the control room, together with the control desk. The contactor panels for the heating element circuits are located alongside the pits and not in the control room.

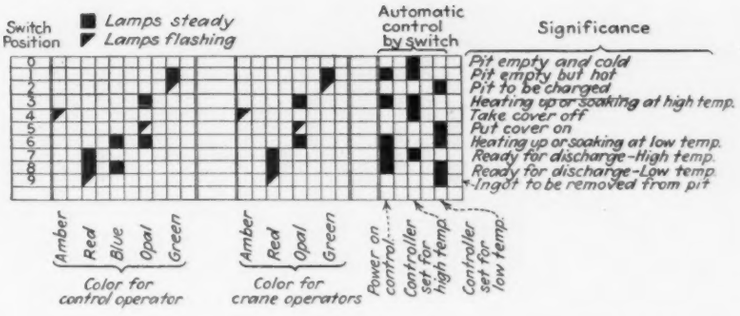
Ingots may be heated to various temperatures and withdrawn from the pits at the temperature to which they were heated and soaked or at a lower temperature. If it is required to cool the ingots below the soaking temperature before they are withdrawn, the cover of the pit is removed for a definite length of time and then replaced, after which the power is again turned on and the ingots allowed to attain temperature equilibrium and uniformity before they are withdrawn.

The temperature of the pits is controlled by special Wilson-Maeulen automatic temperature controllers arranged so that the control temperature may be changed from one to the other of two predetermined temperatures by means of a switch on the control desk without further adjustment at the control instrument.

The control desk, furnished by the Westinghouse Electric & Manufacturing Company, is made up of fourteen sections, one for each pit, each section consisting of the following: (1) At the bottom of the front edge is a nameplate showing the number of the pit; (2) just above the nameplate is the handle of the special Westinghouse type W selector switch; (3) immediately above the switch handle are three red signal lamps, one for each phase of the heating element in the pit; each of these lamps is lighted only when current is actually flowing through the heating element in its respective phase, as determined by the automatic temperature control and the fact that none of the circuits has been accidentally opened; (4) the next five lamps are of different colors —clear, opal, blue, red and green, which are dark or lighted according to the position of the selector switch; (5) at the top of the board is a graduated dial divided into 24 equal parts and numbered for the 24 hours of the day; these dials are used in conjunction with pointers set at different time intervals to insure the proper cycle of operation; the dial and pointers enable the operator to determine at a glance the proper operation program for each pit.

In addition to the signal lamps on the control desk there are four lamps for each pit—red, green, amber and opal—which are mounted on the roof of the control room, where they can be readily seen by the mill crane operator and the gantry crane operator. These lamps constitute the mill signal board and burn in conjunction with the lamps of the same color on the control desk and serve to issue orders to the crane operators. Extra lamps

Control scheme for soaking pits involves use of colored lights



Switch Position "Off"—The power is off and all lamps are dark, signifying that the pit is empty and cold. The temperature controller is set on "High."

Switch Position 1—The power is on and the green lamps are burning steadily, signifying that the pit is empty but hot. The temperature controller is set on "High."

Switch Position 2—The power is off and the green lamps are flashing, signifying that the pit is to be charged.

Switch Position 3—The power is on and the opal lamps are burning steadily, signifying that the ingots are heated up or soaking at high temperature, the temperature controller being set on "High."

Switch Position 4—The power is off and the amber lamps are flashing, ordering the gantry crane operator to remove the cover from that pit. The temperature controller is set on "High."

Switch Position 5—The power is off and the opal lamps are flashing, ordering the gantry crane operator to replace the cover on the pit. The temperature controller is set on "Low."

Switch Position 6—The power is on, the opal lamps are burning steadily and the blue lamp on the control desk is also burning steadily, signifying that the ingots are heating up or soaking at low temperature. The temperature controller is set on "Low."

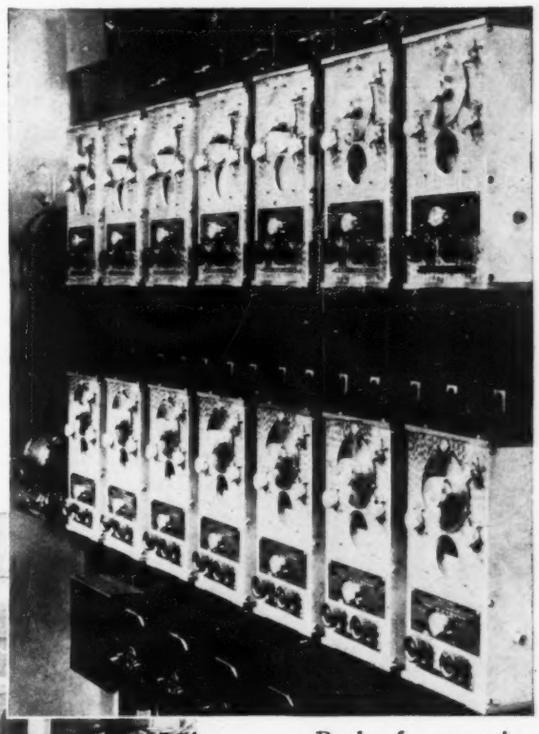
Switch Position 7—The power is on and the red lamps are burning steadily, signifying that the pit is ready for discharge at high temperature, the temperature controller being set on "High."

Switch Position 8—The power is on, the red lamps are burning steadily and the blue lamp on the control desk is also burning steadily, signifying that the pit is ready for a discharge at low temperature, the temperature controller being set on "Low."

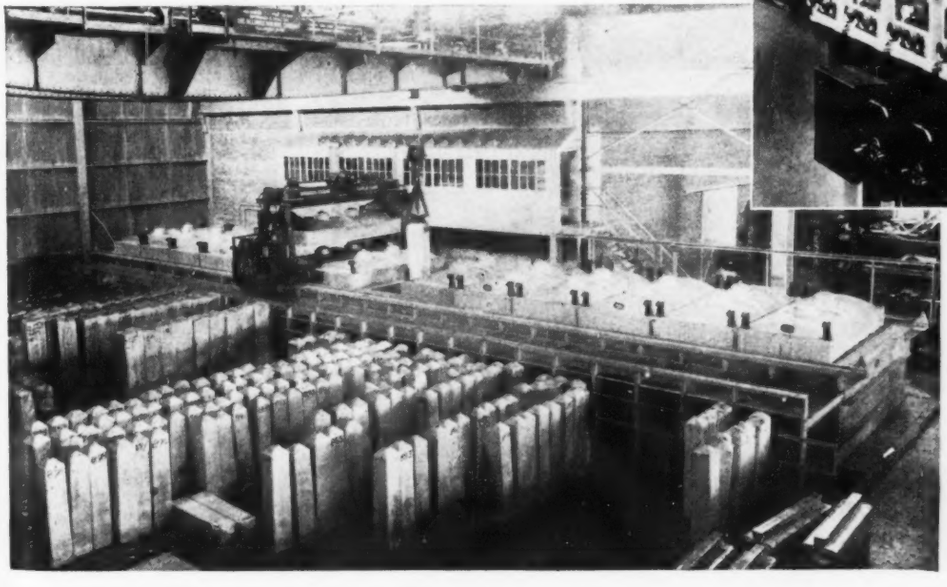
Switch Position 9—The power is off and the red lamps are flashing, ordering the crane operators to remove an ingot from the pit. The temperature controller is set on "Low." Power is on when front three red lamps on control desk burn, one for each phase. Cranemen are not permitted to remove or replace covers unless flashing signal is showing, indicating that power is off in that pit.

on the desk are for condition signals only, while those common to both the control desk and the mill board are action signals that signify that some particular operation is required of the crane operator.

In order to increase the possible number of signals with the minimum of signal lamps and to make some signals more distinctive than others, some lamps may be energized either from a steady or from a flashing source of current. All action signals are indicated by a flashing light. Steadily burning lamps indicate only a passive existing condition in the cycle of operation, requiring no action on the part of the crane operators. The drum type W control switch developed for this service by the Westinghouse Electric & Manufacturing Company is rather special because of the necessity of protecting the



Bank of automatic temperature controllers



Removing ingots from soaking pits

Control room is shown behind the cover lift and crane tongs.

thermo-couple circuits from the 110-volt control and signal lamp circuits.

The disks on the switch shaft and the contact fingers for the thermocouple circuits are separated from the other disks and fingers by a special barrier, and the switch cover is divided into two parts, that part over the control circuit fingers and disks being easily removable, while the part over the thermocouple fingers and disks is secured in place with screws to make them less readily accessible. The connections to the contact fingers for the thermocouple circuits consist of insulated wires passing through the back of the switch rather than binding posts on the back of the switch. With this arrangement there is little danger of any electrician, who may be testing out the control circuits, applying 110 volts to the thermocouple circuits.

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Boundary Heat Resistance Factor in Cable Heating

By LEONARD J. NEUMAN*
Director of Geophysical Research, the Texas Company, Houston, Tex.

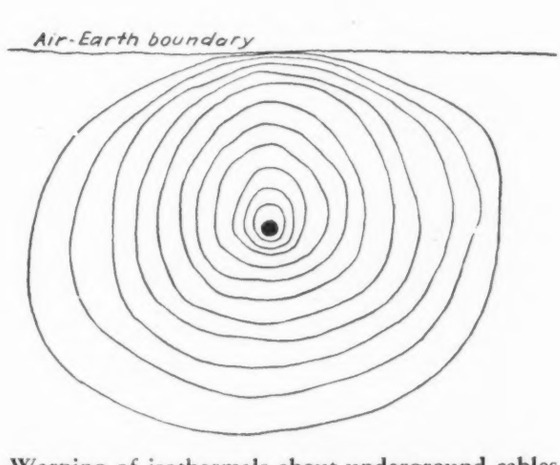
Predetermination of the final operating temperature of a given loaded underground power cable is usually based on the assumption that after a short time most of the heat produced in such a cable either flows to the earth's surface and is carried away by air currents or flows into the earth of infinite heat capacity. The author and his students, G. Vokata and T. Selna, have tested the correctness of these assumptions experimentally for a few particular cases.

Five No. 4/0 jute tar insulated cables were buried 2 ft. to 5 ft. in yellow sand clay soil. The temperature of the soil was measured daily by more than 100 thermocouples placed at regular intervals in a plane perpendicular to the cable to a radial distance of more than 5 ft. The average cable load was 54 watts per foot of cable. It was found that, following the arrival of heat at the earth's surface, above the buried cable, the isothermals about the cable began to warp and continued to do so in all of the five 150-day tests. Now in a radius, say, of 2 ft. about the cable the temperature gradient downward was always greater than that in any other direction (see diagram), and since the heat conductivity of the soil in this 2-ft. radius was practically constant with respect to direction (hence the isothermals began to warp after the arrival of heat at the air-earth boundary, and not before), it is concluded that the greater flow of heat was then downward into the earth of infinite heat capacity.

It was further observed that in each test the temperature gradient in the surface layer of earth above the power cable was greater than the gradient between the surface layer and the cable. This is shown by the diagram. The warping of these isothermals was definitely correlated with the time of arrival of heat at the air-earth boundary. Prior to the arrival of heat at the earth's surface the isothermals about the cable and near the earth's surface were practically concentric circles. It is therefore concluded that the air-earth boundary heat resistance plays an important part in the regulating of the heat flow away from an underground electric power cable at depths as great as 5 ft. below the earth's surface. In so far as the author is aware, this air-earth boundary heat resistance has heretofore been neglected in the underground power cable problem. Attention is called to the fact that boundary heat resistances are known to be of great importance in such problems as heat flow through boiler tubes, furnace walls and fireproof walls.†

The air-earth boundary heat resistance has been found to vary with: (1) Velocity (direction and magnitude) of the air currents above the boundary; (2) the temperature and temperature gradient across the boundary; (3) nature of the boundary (degree of roughness and porosity) and, (4) amount of moisture in the air and surface soil.

The variations in boundary resistance and soil conductivity which are ordinarily produced by changes in season and location would indicate that in general it is probably not economically possible, for the present at least, to predetermine operating temperatures of long power cables through the measurement of soil and air-earth boundary heat resistances. These experiments do, however, lead to a more clear understanding of the importance of the air-earth boundary heat resistance in the underground electric power cable problem. Further, it is now clear why theories describing the heat flow from underground cables, which were based on electrical analogies and experiments performed with cables buried in boxes of earth, failed to predict accurately field operating conditions. Obviously, additional information must be secured for various types of soils and surface conditions before a general theory of any value can be constructed, for there may be cases where the air-earth boundary heat resistance is negligible compared to the average heat resistance of the earth.



Warping of isothermals about underground cables is due to air-earth boundary heat resistance

*Formerly chairman department of electrical engineering, Santa Clara University, Santa Clara, Calif.

†*Hering, Chemical and Metallurgical Engineering, Vol. X, page 40, 1912. "The Flow of Heat Through Furnace Walls," Bulletin No. 8, U. S. Bureau of Mines.*

New Surge Indicator

Flexible and compact installation for steel tower and wood-pole lines. Indicates where insulator flashovers occur. Aids patrol and inspection

By F. B. MENGER
General Engineering Laboratory, General Electric Company

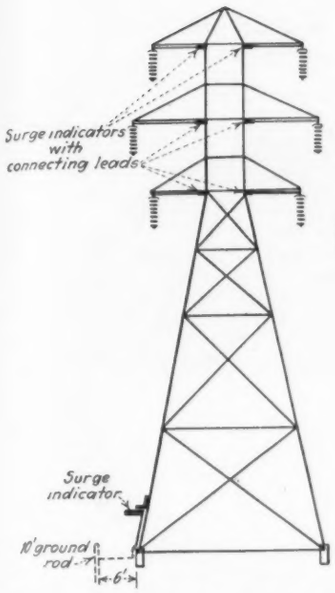


Fig. 1—For indication of flashovers on assemblies and entire tower

EXPERIENCE in the operation of high-voltage transmission lines has shown that in order to keep the number and duration of outages at a minimum it is necessary to detect and replace insulators damaged by lightning flashover. Heretofore such broken or flashed insulator units have been detected by frequent ground patrols, or by a tower-climbing patrol after every severe electrical storm. Obviously, an instrument which would give reliable information on insulator assembly flashover would greatly reduce the work of the ground patrol and practically eliminate the overhead patrol. Such an instrument should be of simple and sturdy construction, should be easily connected to the circuit, should not introduce a hazard to the operation of the line, and should give an immediately visible indication.

A surge indicator which fulfills these requirements regarding installation and operation is now available. The instrument consists primarily of a metal housing, indicating disk and replaceable frangible link. The indicating disk is normally not visible. If the insulator assembly flashes over the link is disrupted and a helical spring drives the disk into a visible position. After operation the indicating disk is reset manually by inserting a new link. The instrument design provides for convenience in mounting and for good visibility from ground when installed at the top of a tower. The housing is 9 in. in diameter and 2 in. deep and is fitted at the back with a mounting clamp with a cupped setscrew and lock nut.

The surge indicator when properly loaded with a trip link ready for operation is electrically an open circuit. The actuating link electrodes are sealed in glass and the gap between them is filled with a small amount of a dry explosive mixture which has a resistance of several thousand megohms. When sufficient potential is applied to cause arc-over between electrodes the explosive mixture ignites and disrupts the link, thus actuating the instrument. The energy required for link disruption is very small, being of the order of 0.1 joule (watt-second). This sensitivity assures operation of the device even on lightning surges of very short duration.

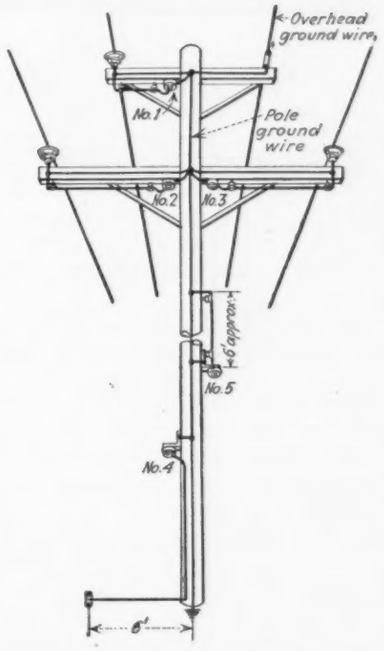


Fig. 2—Wood pole installation of surge indicators

In applying the surge indicator to transmission lines the instrument should be connected so that it can cause no disturbance to normal line operation. Also, the device must be so located that an attendant may service it without danger to himself and without de-energizing the power circuits. The sensitivity of the actuating links makes possible the connection of the instrument in shunt with a portion of the tower structure, or ground wires, carrying the lightning or surge flashover current.

To indicate flashovers of individual insulator assemblies the instruments may be installed as shown in Fig. 1. The surge indicator is clamped, face downward, under the tower arm to the iron at a point near the vertical tower members. The connecting lead should be mechanically strong and supported by small ball or pin insulators, connecting the instrument terminal to the insulator assembly suspension clamps. Some of the details of an installation on a 132-kv. line are shown in Fig. 3. For circuits below 110 kv., or where special tower designs are used, individual analysis may be necessary to determine the most effective method of indicator installation.

Where it is desired to use but one instrument to indicate insulator flashovers on any or all phases an installation as shown at the tower base in Fig. 1 is recommended. This application is most economical and keeps the instrument close to the ground, where it is most accessible

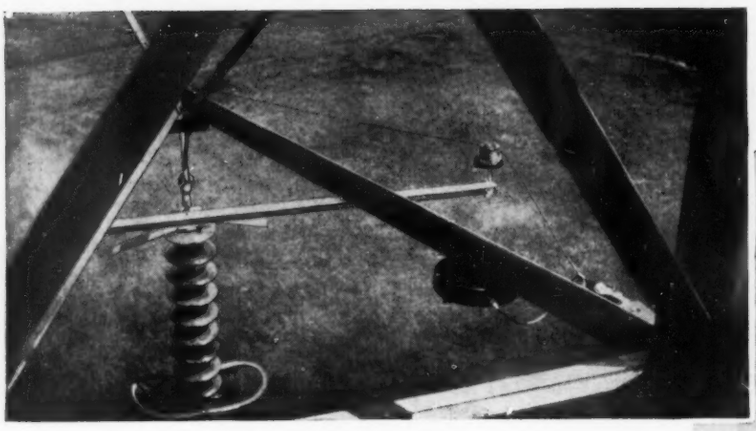


Fig. 3—Surge indicator on 132-kv. insulator

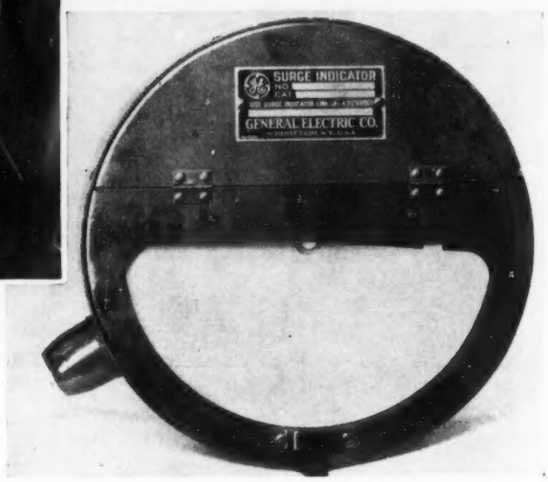


Fig. 4—Surge indicator with target indicating surge

for observation and link replacement. The instrument is shunted across about 6 ft. of ground at the base of the tower, the earth resistance between the tower ground and the instrument ground rod supplying the voltage drop for indicator operation. Such an installation serves definitely to point out to line patrolmen the towers at which insulator flashover or direct strokes have occurred and where close insulator inspections by tower climbing are necessary.

Several methods of installing surge indicators to wood pole lines having overhead ground wire and insulator hardware bonded and grounded are shown in Fig. 2. Indicators Nos. 1, 2 and 3 are connected to indicate individual insulator flashover. The instruments are shunted across the bonding wires between the insulator hardware and the pole ground wire.

Where it is desired to use but one surge indicator to indicate insulator flashovers on any or all phases an installation as shown by instrument No. 4, Fig. 2, may be used. Here the instrument is shunted across about 6 ft. of ground at the base of the pole, the earth resistance between the pole ground and the instrument ground rod supplying the voltage drop for indicator operation. This connection of a single instrument also serves to indicate direct strokes.

Another application of a single instrument is as shown at No. 5, Fig. 2. In this case a portion of the pole ground wire is shunted by the instrument. This method may be used where it is desired to indicate direct strokes, but with somewhat reduced reliability for indicating insulator flashovers.

There is growing practice of introducing a gap in the pole ground wire to utilize some of the wood pole insulation. With this construction it may be desired to indicate flashover of this gap. A surge indicator installed similarly to No. 5, Fig. 2, will serve this purpose. The instrument should be shunted across a portion of the pole ground wire on the ground side of the gap. The surge indicator installed as No. 4, Fig. 2, will give greater sensitivity for the lower flashover currents.

The details of the surge indicator have been designed to secure simplicity and sturdiness of construction and reliable operation. Methods of application to transmission lines make possible easily and quickly arranged installations. The visibility of the trip link permits the attendant to check the link replacement and leave the installation with confidence that the instrument will operate properly. The low cost of the surge indicator, the simplicity and flexibility of its various applications and the negligible maintenance make it an economical device for reducing the labor and cost of patrolling transmission lines. In addition, the surge indicator supplies valuable data concerning lightning and surges on transmission systems.

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German Railways Increasing Electrification

By the end of 1930 the German State Railways had electrified about 985 miles of their railway lines, or 2.9 per cent of the total route mileage of the system. About 815 miles of these lines are main lines and 170 miles are used for suburban service.

The railway company at present has 183 passenger main line heavy-duty locomotives, 216 freight locomotives, 69 motor coaches, 46 control coaches (supplied with controllers for the remote control of the motor coaches), and 169 trailers supplied with electric control cables. The trailers are inserted between motor coaches or between the latter and control coaches in trains serving long-run suburban runs. Further, 836 motor coaches, 651 control cars and 196 trailers are available for the suburban system of large cities and in a great part of Berlin.

Seventy new motor coaches and 196 trailers have been recently ordered to complete the Berlin suburban line service. Three motor coaches and three control cars were ordered for the Hamburg rapid transit.

Motor coaches on the main lines reach a maximum speed of 62 m.p.h. and on the suburban lines a maximum speed of 47 m.p.h.

Inspectors' Aid Needed in Wiring Development

By J. D. NOYES
Detroit Edison Company

Mr. Noyes contends that where wiring costs can be lowered with safety the entire industry benefits from the widening of the market for its service and material.

Range wiring has been cut from $100 to below $40 at Detroit by modifying old regulations and developing new methods through inspection co-operation.

HIRED domestic labor is almost a thing of the past for the great majority of moderately circumstanced American families. A late study shows that 96 per cent of the housewives do their own work. These are the people who want and will use every electrical convenience that will simplify the household task. Out of 26,500,000 families making income tax returns in 1928, more than 12,000,000 have incomes of $2,000 to $5,000 and 10,000,000 have incomes of $1,000 to $2,000. Here lies the domestic electrical market of the future, and it is not an easy one to break into on a large scale. These people are used to squeezing the maximum possible benefit out of every dollar they spend. When they balance the cost of a couple of new outlets in the living room against two new rear tires for the car, who gets the business? Why, the tire dealer and the 5- and 10-cent store—not the electrical contractor and his workmen. The utilities believe that the answer to this problem lies, not in increasingly prohibitory laws, but in the development of better wiring materials and methods.

The utilities believe, and indeed know, that more economical and efficient wiring materials and practices can be developed. When the Detroit Edison Company started to develop its range business it found that it cost from $100 to $125 to change the service entrance and install the range circuit. New materials and methods were developed, and rules were modified with the co-operation of the inspection authority so that it is now possible to do this job at an average cost below $40. As a result, we have sold and contractors have installed about 5,000 ranges since March 1. We believe that a development of this kind is to the advantage of every electrical group, as well as to the public. The contractor is enabled to do a complete job at a price the customer can be persuaded to pay with reasonable sales effort. Such developments extend the field of electrical labor to our millions of inadequately wired houses, a field from which they are now barred because of the absence of suitable materials to do the job.

Bare neutral wiring is one phase of this development. In this country we are rapidly accumulating a considerable amount of field experience which will later be made the basis of code recognition. At Rochester, N. Y., at least 12,000 overhead services with bare neutrals have been in use from fourteen to twenty years without causing trouble. At Evansville, Ind., some 3,000 jobs of all kinds are wired throughout with bare neutral. The Detroit Edison Company has installed a large number of bare neutral service entrances, especially on 60-amp. range jobs. Several branch offices and substations have been so wired. Some of these jobs in Detroit have separate electrode grounding apart from the water piping system, for observation and experiment.

Although neutral grounds often occur, various regulations have long prohibited grounds on the neutral wire inside of the service entrance. As a result of recent discussion on the subject it was decided to check up on this condition by means of a very limited survey. Eleven electric utilities were asked to test for grounds on as many installations as they could conveniently handle. The following data are of interest: Total number of tests, 3,963; total number grounded, 589; per cent grounded, 14.9. One group of 946 tests yields data on low-resistance grounds: grounds of 25 ohms and less, 360; grounds of 3 ohms and less, 346, or 96.2 per cent.

Some of the tests from large cities were identified according to occupancy. The results follow:

Occupancy	No. of Tests	No. of Grounds	Per Cent Grounded
Commercial	574	189	33
Apartments	344	171	50
Residences	602	77	13
	1,520	437	28

In Ohio one operating company reports between 2,000 and 3,000 service entrance installations with bare neutral and two large office buildings wired throughout with this construction. In Indiana this company has about 30 per cent of its new residence services going in bare neutral.

**From an address before the Eastern section of International Association of Electrical Inspectors, Pittsfield, Mass.*

In Charleston, W. Va., the power company's new office building is all bare neutral and the system is used in practically all substation lighting. Experimental and demonstration jobs have also been installed in Pennsylvania, New Jersey, Kentucky, Virginia and elsewhere.

We are, of course, unable to present concrete figures of actual savings because the jobs are relatively few in number and have been installed with present available materials under the more or less restrictive rules of present established practices.

Professor Bennett of the electrical engineering department of the University of Wisconsin recently proposed to use the conduit itself for the grounded side, omitting the bare copper wire entirely in the branch circuit runs. He estimates annual savings of the order of $5,000,000. One of the university buildings is being thus wired.

Some of the survey data, mainly covering residences in small cities and towns but including one large city, indicated the type of wiring as follows:

	No. of Tests	No. of Grounds	Per Cent Grounded
Rigid conduit	280	33	11.8
Armored cable	352	26	7.4
Knob and tube	564	15	2.7

In general, the survey supports the view that grounds on the neutral wire inside the premises are not uncommon, and that their existence does not appear to affect the fire and safety hazard. In fact, many of us have carried on experiments in bare neutral wiring without being aware of the condition.

Two years ago the electric utilities decided to resume an old practice and collect and study the low-voltage fatality record. Some preliminary results of this survey are now available. The data are from official sources, bureaus of vital statistics, coroners' records, special municipal authorities, etc., required by law to investigate such cases. Accidents to the public only (not including utility employees) are included on circuits "150 volts and less to ground." The calendar years 1923 to 1929, inclusive, are covered. The population coverage was from 9,543,768 in 1923 to 25,842,569 in 1929, the attempt being made to relate the data to definite areas and definite populations. The following table gives the classification of results of this survey:

Classification of Accidents

Electrical circuits 150 volts and less to ground.

Class	Number in Present Compilation	Rate per Million Persons per Annum
All cases	106	0.81
All industrial	57	0.43
All domestic	23	0.18
All others	26	0.20
Industrial		
Portable lamps and cords	23	0.17
Involving earth and wetness	16	0.13
Confined spaces	3	0.02
Miscellaneous	13	0.11
Domestic		
Bathtub cases	11	0.08
Wet or flooded basements	5	0.04
Bare or wet earth	2	0.02
Miscellaneous	5	0.04
Other Classifications		
Amateur—experimental and irrational	6	0.05
Aerials and outside wires	9	0.07
During fires	3	0.02
Extension cords under cellarless houses	8	0.06

The notable point, especially with respect to the domestic accidents, is the total absence of any occurrence or practice which might be correlated to code rules governing interior wiring. In other words, we are not justified in assuming that the way to reduce the number of such accidents is to place more restrictions and added burdens of high-priced construction upon the permanent wiring.

The logical conclusion is that the National Electrical Code should be confined to broad statements of basic principles dealing with the fire and casualty hazards associated with interior wiring.

It is felt that many of our difficulties are due to an attempt to combine these statements of basic principles with a handbook or manual of wiring construction practice. Perhaps the industry needs both a code and a handbook, but they should be separate and distinct, and only the former should be authoritative under the terms of electrical laws and ordinances. This may result in more responsibility for the inspector, requiring increased experience and training, but we submit that such responsibility must be assumed if the inspection group is to retain its present high standing and value in code affairs.

The electric utilities believe that "codes and other collections of rules and regulations when offered for promulgation as national standards may enunciate principles to which assent is given. They should contain a minimum of quantitative requirements. Detail specifications are highly objectionable."

How can we work out a solution to these very important questions? For one thing, it is evident that some way of trying out new developments will have to be recognized. The National Electrical Code necessarily treats of standardized, established practices and one cannot standardize experimental and development work. The utilities suggest that it will be to the benefit of all concerned to have wiring development carried out under the competent and responsible supervision of the power companies. Such are in intimate contact with the requirements of their customers and surely cannot be accused of a desire to initiate any program which could possibly injure those customers or their property. The utilities desire the co-operation and assistance of inspection authorities to permit properly controlled experiments by responsible parties. They hope for a liberal attitude toward such requests both in local jurisdictions and at executive headquarters. They do not recognize that any unofficial body has the jurisdiction or the competency to pass final judgment upon such matters. The industrial greatness of the United States rests upon a willingness to try out any new idea and to discard old methods when better ones appear. This right to experiment and progress must not be curtailed.

The local inspection authority has the right, by virtue of the police power under which it operates, to enforce such rules and regulations as have legislative approval. It usually has the right to make such local rules and regulations as seem to be called for under the conditions existing. It should always have that right. The field trial experience leading to final code acceptance has always in the past been obtained under such conditions of controlled and supervised experiment. We believe that this will continue to be the case in the future, and we plead for a broad tolerance in your consideration of these problems. We believe the public which you and we both serve are entitled to that consideration. We will progress further and faster in a spirit of fair-minded common sense rather than a blind adherence to code and ritual.

Communication Distribution in a Large Office Building

By JAMES A. WALSH

Engineer L. K. Comstock & Company, New York, N. Y.

The Empire State Building has ample facilities provided for such miscellaneous services as telephone, tickers, Western Union and Postal messenger calls, etc. For this purpose there are twelve 3½-in. conduits entering the building on the 33d Street side from the subway system in the street. These conduits are all continued on the sub-basement ceiling from the building wall to a centrally located room, which is divided for the use of the various companies. Leaving this room there are approximately 40 3½-in. conduits, distributed on the sub-basement ceiling to the lowest levels of the respective electric shafts. Communication ducts are separated as far as possible from secondary ducts occupying the same riser shafts.

In each shaft on each floor there were provided, in general, two large interconnection cabinets 72x40x6 in., one for telephone and one for miscellaneous signal use. Sleeves through the floors permit the installation of cables vertically in the shafts. No conduit is used for such cables except where an offset occurs in a shaft. In such cases conduit jumpers are installed horizontally on the ceiling to join the shafts together. To provide for flexibility in cabling, the shafts on each floor are all tied together with 1½-in. conduits run in the floor-fill close to the core walls.

In addition to the shaft boxes, smaller interconnection cabinets are distributed about the floor, there being one for approximately every 40 ft. of periphery. Approximately half of these boxes are for telephone only, the other half being used for both telephone and miscellaneous signals. The boxes for telephones only are 18x24 in. and the others are 24x24 in. The smaller boxes are all connected by conduits, run in the floor slab to the shaft interconnection boxes, the telephone conduits being 1¼ in. and miscellaneous conduits 1 in.

Normally such small cabinets for interconnection are placed on the exterior columns or walls, but in this building they were installed on interior columns, which are of such size as to accommodate them easily without appreciably increasing the furring necessary to conceal them. This location brought them nearer to the shafts and thus shortened all the conduits for interconnection with the shaft boxes. It also kept them out of the spaces most often selected for private offices and brought the 1¼-in. interconnecting conduits into the area not crossed by underfloor duct.

▼

Sawmill Problem Solved by Double-Motor Drive

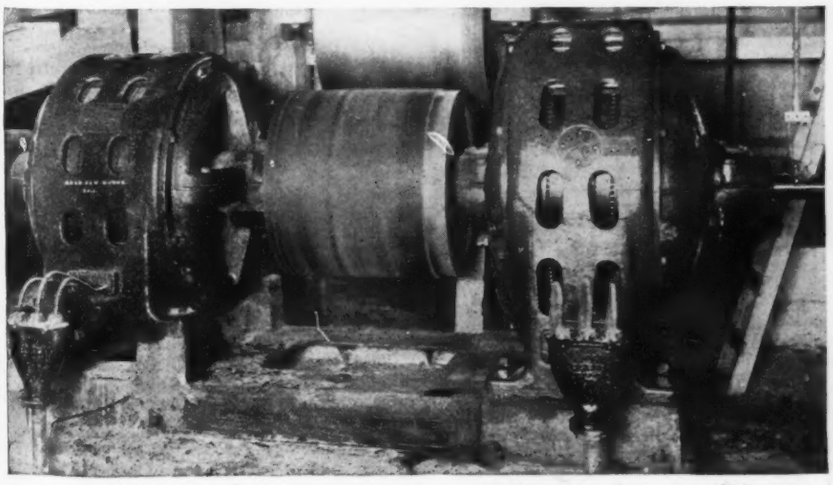
Use of a double-motor drive of an unusual nature to operate the headsaw at the Enumclaw, Wash., plant of the White River Lumber Company has simplified the cutting of lumber, reduced losses and paid for itself in less than three months.

This double-motor arrangement replaced a single-motor drive, utilizing a 300-hp., 600-r.p.m., wound-rotor motor. The single motor was not satisfactory when cutting frozen logs because of the high speed of the saw (10,000 ft. per minute at the periphery), resulting in a snaky cut. Reducing the speed by inserting resistance in the secondary was not satisfactory because the speed varied with the load. Between cuts, when the motor was practically unloaded, it would speed up to nearly synchronous speed and would cut half way through the log before the speed was reduced to a point where it would not make a snaky cut.

Arrangements were made, with the co-operation of General Electric Company engineers, whereby a 300-hp., 450-r.p.m., squirrel-cage motor was direct connected to the shaft of the wound-rotor motor so that either motor could be used to drive the saw. The slow-speed motor is used for the extremely hard and frozen logs and the high-speed motor cuts the other logs.

The control is so arranged that the equipment can only be started with the wound-rotor motor. This motor is started with an automatic starting panel mechanically interlocked with the oil-immersed primary magnetic switch of the squirrel-cage motor, making it impossible to have power on both motors at once. A speed-limiting relay makes it impossible to close the line contactor of the squirrel-cage motor unless it is running at a speed somewhere between 425 and 450 r.p.m. This eliminates the possibility of high-current inrushes which would result if the motor were thrown across the line at other speeds.

The result was the elimination of snaky lumber, a reduction in the cost of planing, faster production and reduced lumber losses. This brought about the saving of the initial cost in the short time mentioned.



Double-motor drive reduces lumber mill costs

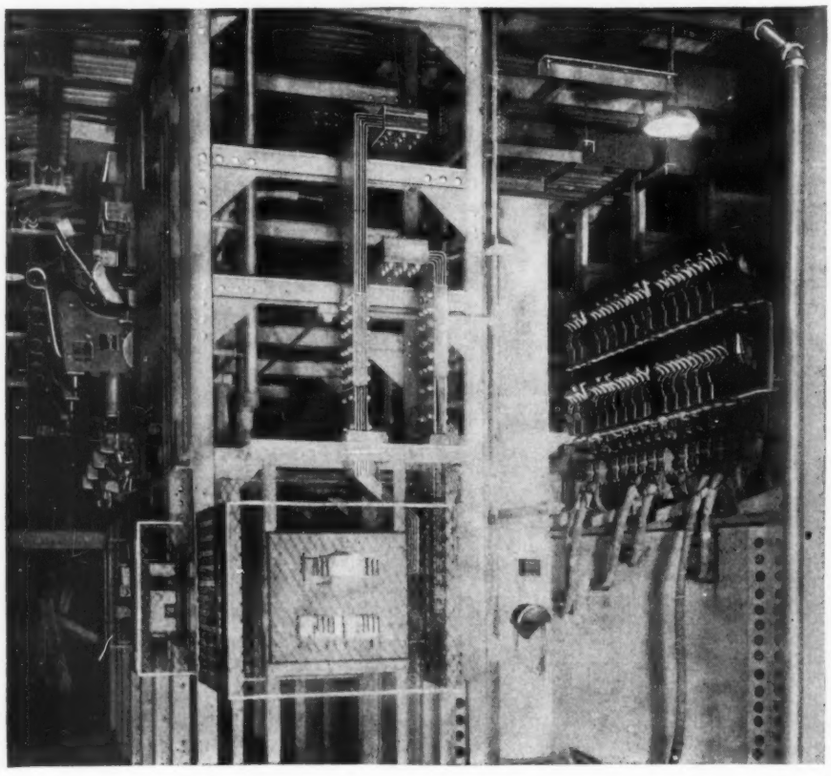
Meeting Space Limitations in Urban Substations

Few tasks of the engineer require better use of a trained imagination than the design of substations for downtown service in large cities. Variations in conditions are extraordinary and the value of real estate and cost of building construction put a premium on space economy.

Various basic principles of design affecting space allocation and a number of detailed features of economical treatment in equipment placement by power companies in eastern New England are cited.

CONFLICTING requirements in the design of city substations to meet present demands and future needs make the problems of equipment disposition rather difficult. The relatively high cost of real estate limits the designer at every turn. The operating man seeks a convenient and safe layout, which spells space in rural and suburban substations and creates pressure on the available area downtown if apparatus, cables and switchboard facilities are to be packed into the volume economically usable above and below ground without jeopardizing safety and convenience. Once again the engineer is asked to provide the best installation he can without inflating the cost or handicapping the service, and the answer is likely to be a compromise between cost and convenience, since in many cases the growth of downtown loads forces the company to plant a substation close to the load center of a specific neighborhood and to make use of a site more or less difficult in shape from the engineering standpoint.

It would be as absurd for a clothier to expect a "hand-me-down" suit to fit all customers of a specified age and weight as to assume that one set of plans for a city substation of a given rating can be satisfactorily applied to another without alterations. Great progress has been made in the design and construction of substations on the unit principle during the past decade, pioneer work having been done by the central stations and manufacturers in this field, but these installations have fitted suburban conditions. The close engineering observer can detect trends toward standardization in city substation work and can "spot" the handwriting of particular groups of designers on many jobs, to put it colloquially. The major problems of equipment ar-

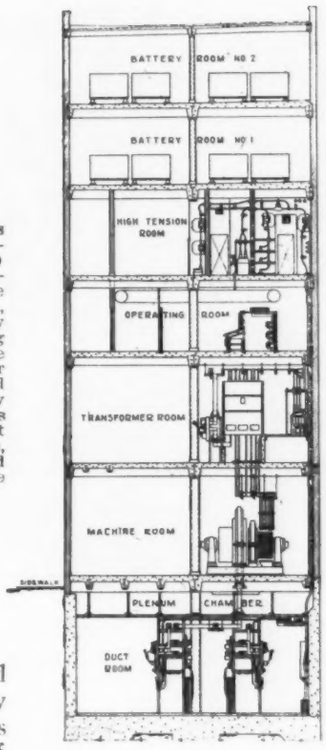


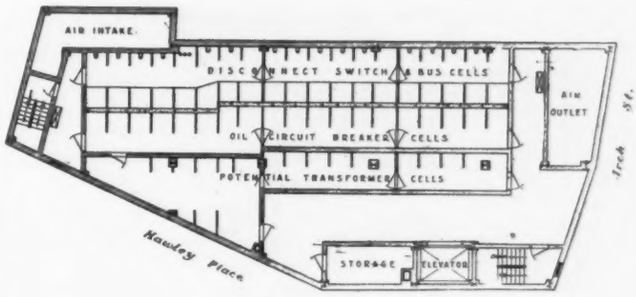
Direct-current breakers grouped on positive and negative buses

The positive and negative cables leave in separate duct stacks and are controlled by separate bus selector circuit breakers mounted on separate steel structures on which are carried the high and low potential buses of the respective polarities. The machine breakers are mounted on the same structures but on the extreme outsides, while the feeder breakers face each other. Great economy of space is realized by this arrangement of breakers. The machine leads are very short in comparison with substations having hand-operated switches.

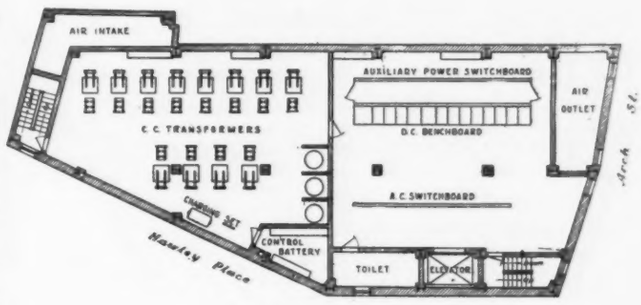
Limitations of small irregular plot offset by carrying out unit idea vertically

The ultimate capacity of this installation (Arch Street substation, Boston Edison Company) is 18,720 kw. in six rotary converters. The apparatus, with the incoming and outgoing cables, transformers, two stand-by storage batteries and switching and control equipment, had to be accommodated on an irregular lot about 120x45 ft. Space and material were saved here by placing associated apparatus directly above or below nearest interconnected units. Short bus, wire and cable runs resulted from this "plumb line" scheme of layouts.

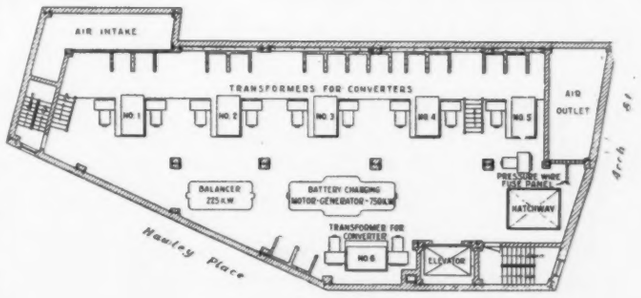




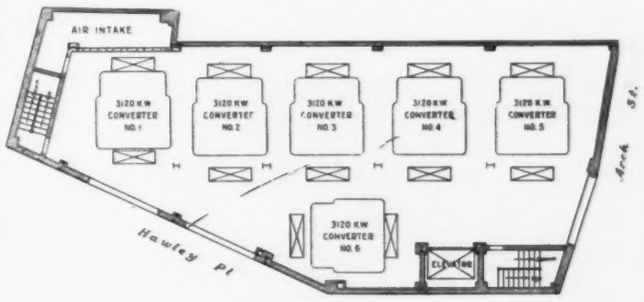
HIGH TENSION CELLS



OPERATING ROOM



TRANSFORMER ROOM

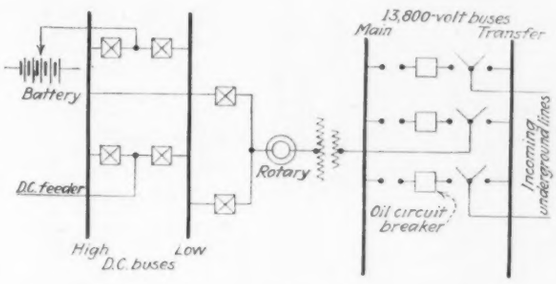


MACHINE ROOM

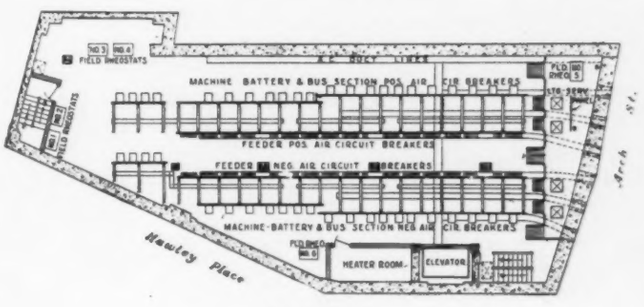
rangement, however, depend upon factors which vary widely in practice. This means that any survey of the subject of space allocation to be of service at present should be based upon the examination of recent particular designs, since no general solution of the urban substation problem can as yet be presented.

Urban substations usually deliver relatively low-voltage energy to areas of high-load density after its transformation from high-voltage alternating current. The final design of the city substation may be regarded as the common denominator of a number of factors, the most important being magnitude and character of load to be served now or later, type and capacity of input and output circuits required, tie line relationship of the substation to adjacent distributing units from the standpoint of service quality, size and shape of site, access to existing transmission and distribution system, facilities for handling machinery and supplies, exposure to external injury, elimination of noise and the increasingly vital matter of ventilation.

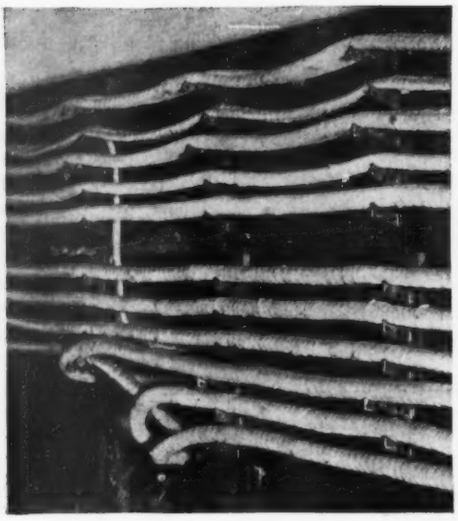
No single element of substation design can be safely stressed at the expense of others, but symmetry of equipment arrangement is certainly one of the fore-



Basic wiring scheme of Arch Street substation


NO. 3 NO. 4 FIELD RHEOSTATS
NO. 1 NO. 2 FIELD RHEOSTATS
A.C. DUCT LINES
MACHINE BATTERY & BUS SECTION POS. AIR CIR. BREAKERS
FLD. RHEOS. NO. 5
LTG. SERV.
FEEDER POS. AIR CIRCUIT BREAKERS
FEEDER NEG. AIR CIRCUIT BREAKERS
MACHINE-BATTERY & BUS SECTION NEG. AIR CIR. BREAKERS
FLD. RHEOS. NO. 6
HEATER ROOM
ELEVATOR
Arch St.
Hawley Place

DUCT ROOM

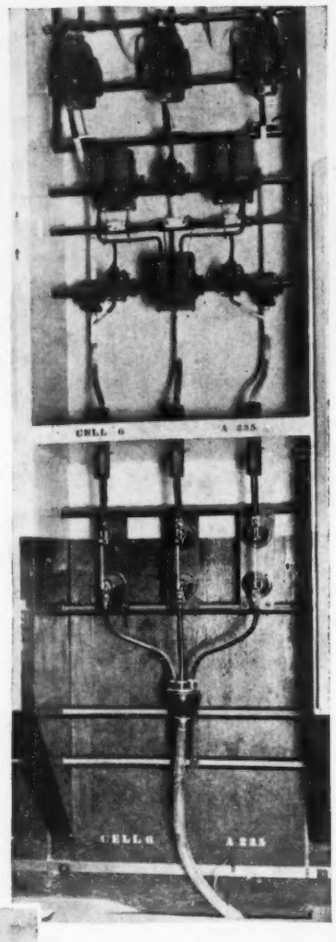


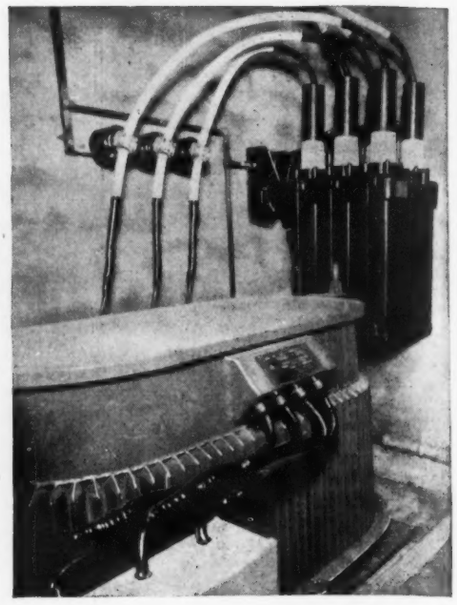
Compact but accessible arrangement of cables

At the Blackstone Street substation of the Cambridge (Mass.) Electric Light Company the cables are racked on brackets which can be built up in sections to accommodate a maximum of three cables per bracket (5½ in. between cable centers vertically).

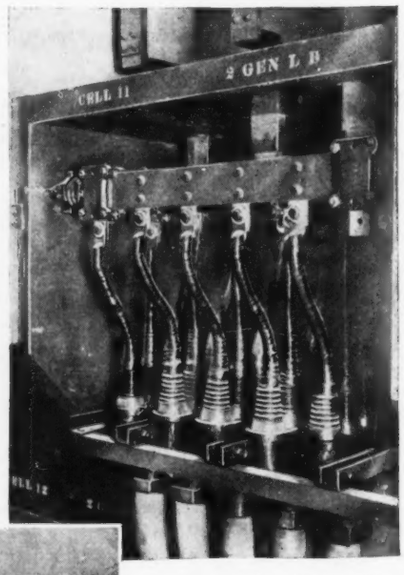
Disconnecting switches, potential and current transformers mounted on pipe frame

2,300-volt cell at Blackstone Street substation.





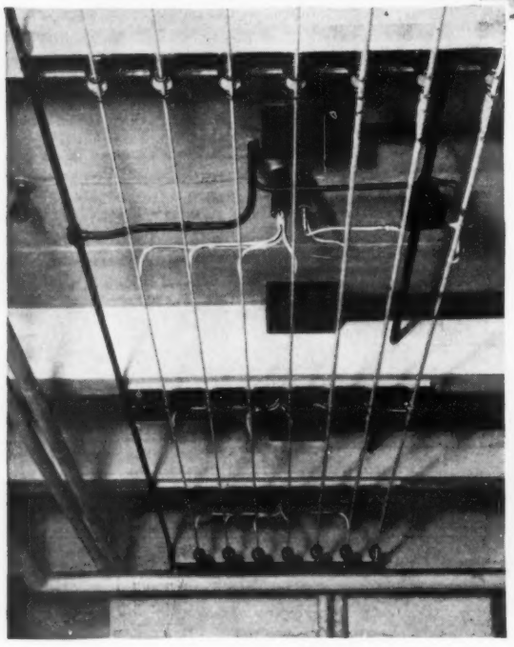
Accessibility provided in limited space by curved cable runs



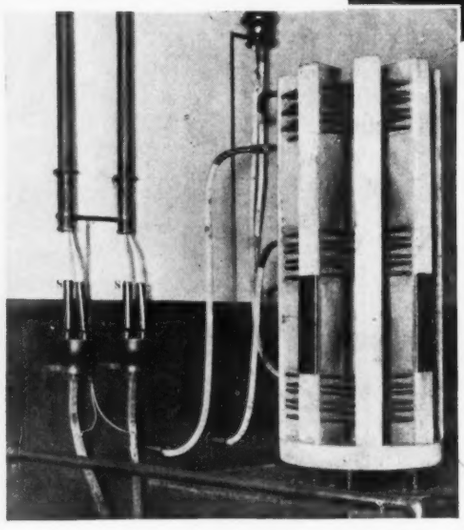
Five 600,000-circ.mil cables in parallel per phase and their associated potheads are supported compactly and substantially in this cell, 3 ft. 8 in. wide, by using 2-in. steel angles braced with channel irons. Bus taps at 2,300 volts are made in the upper part of the cell.

Utilizing ceiling space between substation girders

Note current transformers for overcurrent and under-current protection and junction boxes for outgoing street lighting cables.



A heavy capacity junction box



Street-lighting cable potheads and reactor

Micarta tubes are employed as bushings and the grounding installation is simple and direct between sheaths, conduit piping and earth bus.

most factors in space economy, operating convenience and safety. On contracted and irregular sites a building several stories high will provide a surprising degree of symmetry all the way from the cable vault to the roof. It will also enable a designer in many cases to attain a reasonably satisfactory spacing of equipment, of course at the cost of pushing a design into the air.

Non-symmetrical layouts tend to pile up apparatus in irregular masses, to overcrowd equipment at points which may become critical in emergencies, and to complicate the handling of machinery and electrical material in construction and maintenance. These also tend to throw cell sequences and circuits out of line, increasing the space required in switch and bus segregation. Hence the adoption of unit principles of design, even in a substation which is developed in but two or three sections, conserves space within the minimum clearances permissible.

Ventilation a serious problem

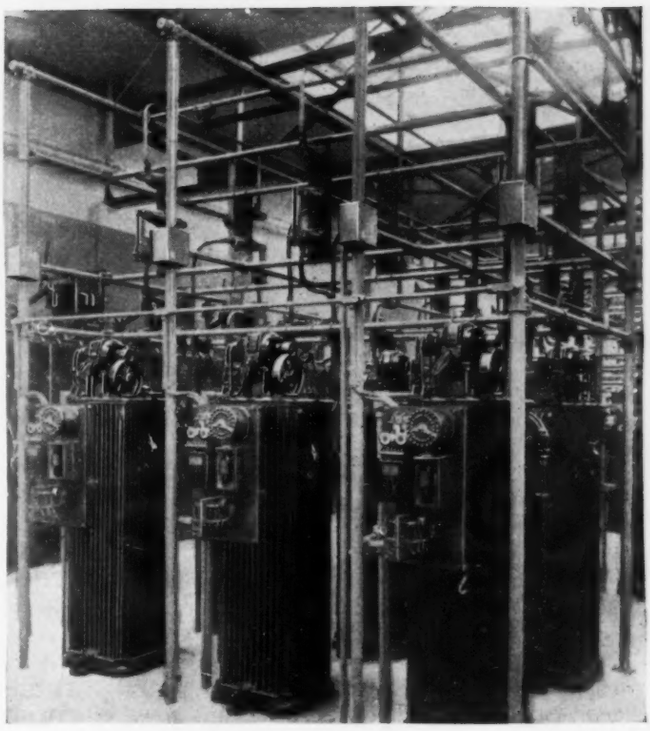
Ventilation has become a controlling element in urban substation design. Its successful treatment is a complex problem which cannot be covered in an article on space allocation, but it profoundly influences the design of the building and size and location of conversion apparatus. The present trend appears to be toward a comprehensive system of motor-driven fans, ducts and dampers, utilizing roof space and wall volumes to the fullest advantage and freeing substation interiors from bulky machinery for air supply and removal.

Increases in the size of rotaries have forced engineers to provide full or partial metal housings around these machines, with intensive directed ventilation which is expected to facilitate greatly the automatic removal of copper dust and other minute débris from insulation throughout long operating periods. It is pointed out that to some degree will such housing inconvenience repairs to equipment and in some cases the resulting encroachment upon operating room space may become burdensome. The amount of heat dissipated by large rotaries seems to leave no alternative to the designer.

Ventilation of storage batteries appears to have been satisfactorily solved without giving the substation designer much concern about the space required for equipment needed.

Clearances Used by Boston Edison Company Station Engineering Department

Voltages	Radius of Danger Zone Around Live Parts, In.	Minimum Vertical Clearance of Unguarded Live Parts, Ft. In.	Minimum Horizontal Clearance of Unguarded Live Parts, Ft. In.	Minimum Clearance from Live Parts to Guards, In.
300– 750	2½	7 8½	3 2½	2½
751– 2,500	3	7 9	3 3	3
2,501– 4,500	3½	7 9½	3 3½	3½
4,501– 7,500	4	7 10	3 4	4
7,501– 15,000	6	8 0	3 6	6
15,001– 25,000	9	8 3	3 9	9
25,001– 37,000	12	8 6	4 0	12
37,001– 50,000	16	8 10	4 4	16
50,001– 73,000	22	9 4	4 10	22
73,001– 88,000	28	9 10	5 4	28
88,001–110,000	33	10 3	5 9	33
110,001–132,000	40	10 10	6 4	40
132,001–154,000	47	11 5	6 11	47
154,001–187,000	55	12 1	7 7	55
187,001–220,000	64	12 10	8 4	64



Pipe framework permits compact but accessible arrangement

Feeder regulators are grouped in sets of six in a floor space only 10 ft. 4 in. x 7 ft. 1 in. in dimensions in the Cambridge Electric Light Company's principal substation. Buses are supported overhead on insulators mounted symmetrically on pipe framing, and switching is unified without encroaching on valuable outside space. All outgoing 2,300-volt feeders are provided with a regulator per phase in this substation.

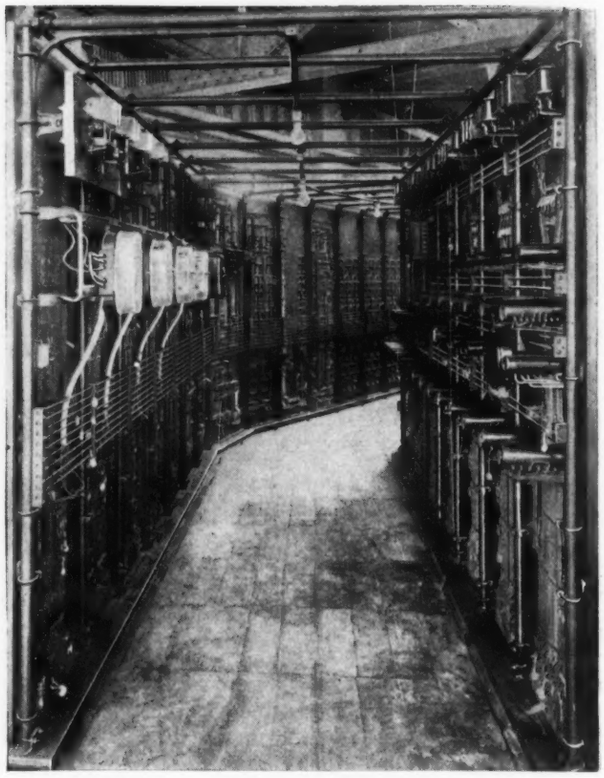
Use of elevators in multi-story city substations has attained considerable proportions. The "hay-hoist" method of lifting heavy material to the upper floors of the building has pretty much gone into the discard. Protection against the conflagration hazard demands almost a military type of building construction, and outside doors at different floor levels served by a heavy hoist at the top of the building are viewed askance by designers. Space must be sacrificed within the building to provide elevator and stairway facilities capable of serving both personnel and equipment under all conditions.

In highly congested areas the disposition of wires and cables in connection with particular substations is conditioned largely by the system formation location of neighborhood loads and space limitations within the building. Amazing variations are encountered in different installations on the same system and no uniform allocation of space is feasible, although "family resemblances" may appear in the substation layouts of a particular company. Cable entrances and exits may be on opposite sides of the building, on the same side, or split diversely. Conversion machinery may occupy common quarters with transformers or be placed in separate rooms; regulators may be set in close banks or adjacent to feeder switch cells; switches may be remote-controlled or hand-operated, and storage batteries, if required, may be at the top of the house or elsewhere. In all these ramifications of design the

problem of true space economy resolves itself into a number of objectives, limited, indeed, by specific local conditions, but susceptible in many instances to control through a sufficiently wide range to yield gratifying results.

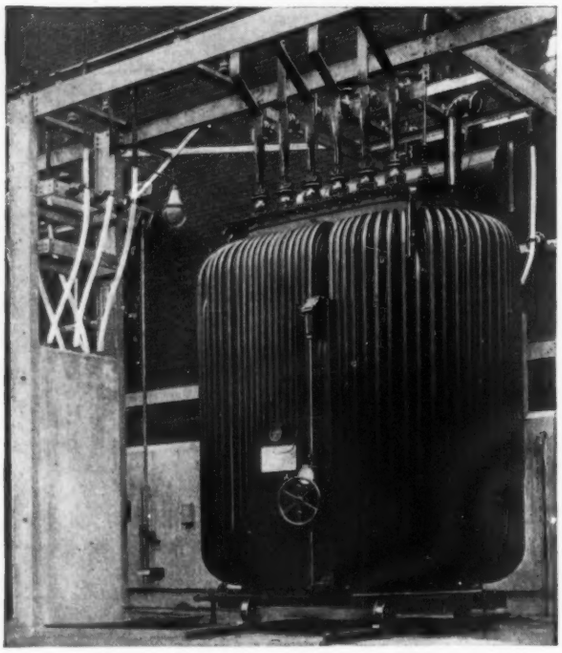
Clear-cut expression of electrical requirements in the schematic wiring diagram aids the designer in space allocation, even though such diagrams may bear little resemblance to the geographic situation. In these the basic principles of bus sectionalization, the grouping of incoming and outgoing feeders, electrical arrangement of switches and breakers, transformer banks, jumpers, etc., are brought to the sharpest possible focus. Working from these diagrams, the translation of equipment functions into apparatus sizes and locations proceeds logically toward the most skillful utilization of the available space. Cardboard templates which are cut to scale speed up decisions as to feasible arrangement on the outline scale drawings. Minimum spacings of live conductors set extreme bounds which must not be curtailed.

Where conditions permit it, the substation "production cycle" will be based on the "through" transit of energy from entry to exit points. Where "doubling back" of energy travel cannot be avoided, the effort will be to achieve the most uniform and symmetrical arrangement possible, avoiding intricate runs of power wire and cable, steering free from complications of conductor placement, and providing an easily followed physical layout. Much control, measurement and auxiliary wiring is essentially more or less intricate, but with proper tagging this is not a serious drawback from the standpoint of space utilization. Many of these circuits are operated at relatively low voltages, require small conductors and can be grouped in ducts or exposed conduit and terminated in junction boxes and cabinets which provide for all the sectionalization desirable without impinging materially on the space situation. The real problems are associated with the heavy-duty equipment.



Semi-hexagonal switchboard with ample aisle space

At Cambridge, Mass., the lighting company's main switchboard in its chief substation contains 21 panels, each 24 in. wide, installed in three offset sections of seven panels each to keep within the available operating room area. At the rear a section devoted to relays and other auxiliary equipment for measurement and control service parallels in front board, with 4 ft. 10 in. between the two for operators' and maintainers' convenience. This semi-hexagonal arrangement is compact without crowding. The station rating is 22,750 kw.



Simple bus connections

In this new substation of the Narragansett Electric Company short copper bars connect transformers and overhead buses and cable connections are brought up through concrete ducts between I-beams. Besides notable economy in the use of steel and conductors this arrangement conserved space without sacrificing flexibility or hampering construction and maintenance work.

Accessibility for inspection and repairs is the operating man's acid test of design convenience. To achieve this, constant thought is being given by substation layout men to the feasibility of increasing clearances above the safe minima. Nothing is more surprising in a critical study of early electrical construction than the failure of many designers to visualize the trouble inherent in cramped installations. Too much blame should be withheld from their shoulders, since they did not think in scores of kilovolts, and the art owes much to the broader conceptions of spacing forced upon the engineers of the past by rising potentials. Mechanical convenience often outruns electrical necessities in the space allocation of apparatus and material, especially in direct-current bus construction, aisle provision between machine units and battery cell rows, headroom and wall clearances.

Many pages could be written upon bus and switch cell construction from the standpoints of arrangement, sectionalization to attain operating flexibility and conductor isolation. The question of dimensions and clear-

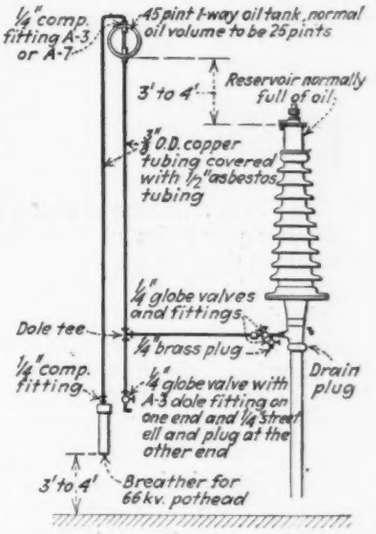
ances has tended toward a fair band of uniformity resulting from the over-all mounted dimensions of well-established lines of circuit breakers, switches and transformers for instrumental and control service. In cell dimensions there seems to be less opportunity for justified economies of space than in the heights of some bus and switch rooms from floor to ceiling. Even here a liberal program pays from the safety standpoint. In this connection the vertical sectionalization of bus and switch compartments may increase the total space needed slightly on account of the barrier thicknesses, but it deserves attention in downtown installations where large amounts of energy may be concentrated upon one point in case of short-circuit conditions. Minor space economies are being realized in some cases by mounting current transformers under ceilings, but the sizes of feeder breakers determine many cell widths near or at the floor, and it is simpler from the standpoint of construction to maintain these widths in upward runs of conductors than to contract the cell dimensions by varying the forms or modifying runs of brickwork.

Alternating-current substations in urban centers are freed from many complications associated with heavy direct-current distribution and enjoy corresponding space-saving opportunities. A high degree of symmetry is generally possible, and this, of course, works toward reasonable compactness of layout, as may be seen in some of the accompanying illustrations. The advent of the alternating-current network system in downtown areas opens the way toward significant and important developments leading toward immense savings in valuable space through the utilization of transformer vault construction and the decentralization of transformer capacity. The study of alternating-current substation design bids fair to be of interest for a long time in the less congested areas of cities and suburbs, but the future of such installations in metropolitan centers is fraught with question marks. The whole subject of substation design is likely to challenge the best efforts of the engineer in the distribution field for many years to come.

▼

Gravity Oil Pressure on Cable Terminals

Gravity oil reservoirs are used on the 66-kv. cable terminals of the Commonwealth Edison Company according to a recent report of the underground systems committee on oil reservoirs and accessories for underground cable. This type of reservoir has been found to be less troublesome than others, particularly since beginning the use of compression fittings in the oil line after wiped joints had been tried. It was discovered that this latter method required more time and skill for installation and that large numbers of leaks developed around the various fittings.


1/4" comp. fitting A-3 or A-7
45 pint 1-way oil tank, normal oil volume to be 25 pints
3' to 4'
Reservoir normally full of oil
3/8" O.D. copper tubing covered with 1/2" asbestos tubing
1/4" globe valves and fittings
Dole tee
1/4" brass plug
1/4" comp. fitting
1/4" globe valve with A-3 dole fitting on one end and 1/4 street ell and plug at the other end
Drain plug
3' to 4'
Breather for 66 kv. pothead

Edwin Gruhl Declares*

Advertising Benefits Far Exceed Costs

This is a period of world readjustment of standards of economy and efficiency. In the circumstances it is refreshing to note that certain expenditures yield benefits so far in excess of the sacrifices they entail that they may be termed "minus costs." One such cost, for instance, is advertising. Every one knows that wisely applied advertising results in greater economy for the seller and lower cost for the purchaser.

Advertising is the principal factor in lessening the cost of distribution. Electric power is the principal factor in lessening the cost of production. Fundamentally both have contributed to the reduction of cost to the ultimate consumer. On the basis of United States government statistics, both have done more to increase the spending power of the American citizen than any other factors in this country's remarkable industrial and commercial development.

Always it has been a matter of increasing wonderment to me that these important "minus costs" are relatively such an insignificant part of the total cost to the consumer. The research bureau of the Advertising Federation of America has directed attention to the fact that the "two-billion-dollar advertising bill is less than 1½ per cent of total sales." The average cost of electric power—without considering other fuel—probably does not exceed the average cost of advertising. Each is an amazingly small part of the consumer's dollar.

Both the advertising and electric power industries suffer from misconceptions of these important facts on the part of many persons.

Salvation lies in the "minus costs" we can create. A hopeful sign for the prosperity which is ahead is that only 53 per cent of factory machinery is motivated by electricity and of manufactured products less than 50 per cent is sold through advertising.

Excerpts from address of vice-president and general manager North American Company before Advertising Federation of America.

Circuit Breaker Duty Affected by Circuit Characteristics

By WILFRED F. SKEATS

Switchgear Engineering Department,
General Electric Company, Schenectady, N. Y.

THE interrupting duty of a circuit breaker is commonly expressed in terms of the voltage existing before short circuit and the current flowing in the arc. It is a matter of common experience, however, that other properties of the circuit have an important effect upon the rupturing performance. These properties are summed up in the recovery voltage characteristic of the circuit.[1]

Two features of the recovery voltage characteristic are of primary importance (1) The magnitude of the voltage attained, and (2) the rate at which the voltage rises to this value. These two features are conveniently determined separately, for the magnitude of the voltage obtained depends largely upon the comparatively low-frequency transients, while the rate of voltage rise is determined by transients of a much higher frequency. The phenomena affecting the magnitude of the voltage are discussed first.

The oscillogram of Fig. 1 shows a recovery voltage peak more than twice the crest value of the normal voltage across the breaker pole. Such a value does not always occur, but even higher ones are quite probable in the case of three-phase short circuits near hydro-electric stations. The magnitude of the first peak of recovery voltage depends primarily upon the type of short circuit, the characteristics of the rotating machinery and the displacement of the current wave.

Neglecting for the moment the effect of rotating machinery, the magnitude of recovery voltage is affected by the type of short circuit as follows:

1. In a single-phase short circuit the recovery voltage is the same as the voltage before short circuit.

2. In three-phase short circuits the recovery voltage of the first phase to clear varies from zero to 1.5 times the leg voltage of the system as the zero phase sequence reactance varies from zero to infinity.

3. In two-phase-to-ground short circuits the recovery voltage of the first phase to clear varies from one-half line voltage to full line voltage as the zero phase sequence reactance varies from zero to infinity.

The following effects arise from the behavior of rotating machinery under short-circuit conditions:

1. It is well known that the current flowing in a short-circuit in general suffers a decay from its initial value before the sustained value is reached. This decay in current is a manifestation of decay in the rotor flux of rotating machinery and is therefore accompanied by a corresponding reduction in recovery voltage. Thus in all types of short circuit the recovery voltage is reduced in proportion as the current decays from inception to interruption of short circuit.

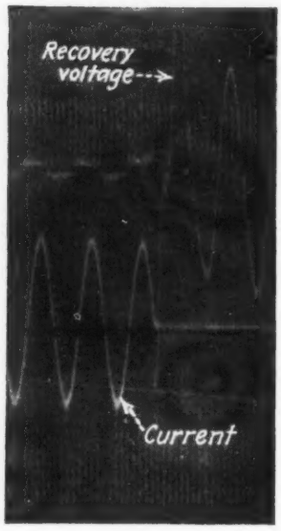


Fig. 1—Recovery voltage double normal

Current and voltage of the first phase to clear of a three-phase short circuit on 13,200 volts on a 100,000-kva. generator without an amortisseur winding operating with the neutral ungrounded.

2. In a three-phase reactive short circuit, at the time of clearing, the first phase to clear links the quadrature axis of rotating machines, and the recovery voltage is therefore determined by the reactance (x_q) of these machines in the quadrature axis. This reactance is usually higher than the subtransient, or instantaneous, reactance (x_d) in the axis of the poles, the ratio being roughly as given in Table I. For a short circuit at the generator terminals the recovery voltage is increased by the quadrature reactance factor as given in Table I. If the short circuit is at some distance from the generator, however, these factors are correspondingly reduced.

Table I—Quadrature Reactance Factors

Types of Machine	Ratio $\frac{x_q}{x_d}$
Turbo-Alternators:	
(*a*) Laminated rotor	2.5
(*b*) Solid rotor	1.4
Salient-pole machines:	
(*a*) Without amortisseur	2.3
(*b*) With amortisseur	1.1
Induction motors	1.0

This factor applies to all three-phase short circuits and to two-phase-to-ground short circuits with very low zero phase sequence reactance. It does not apply to any single-phase short circuits nor to two-phase-to-ground short circuits with moderate or high zero phase sequence reactance.

[1] *For a more complete discussion of recovery voltage phenomena see Park and Skeats, "Circuit Breaker Recovery Voltage," presented at the Middle Eastern district meeting No. 2 of the A.I.E.E., Philadelphia, Pa., October 14, 1930.*

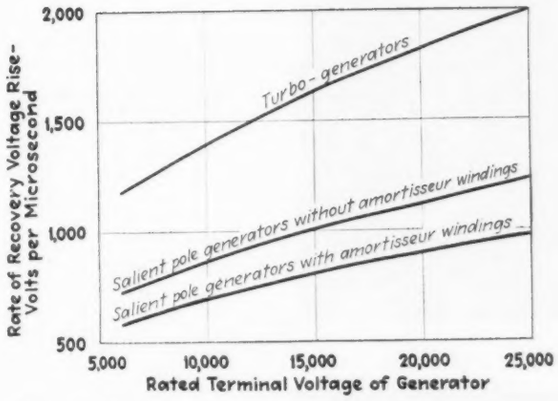


Fig. 2—Rate of recovery voltage rise for three-phase ungrounded short circuits at generator terminals

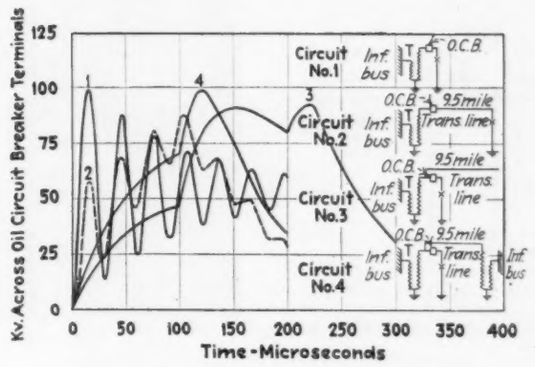


Fig. 3—Recovery voltage affected by line conditions

Calculated recovery voltage curves following a single-phase line-to-ground short circuit at points marked X on circuit diagrams. Capacity of transformer in each case: 20,000 kva. per phase; transformer reactance 10 per cent. Transmission line surge impedance 400 ohms.

The magnitude of the recovery voltage is equal to the leg voltage before short circuit multiplied by the product of these three factors, the factor for the type of short circuit, the decrement factor and the quadrature reactance factor.

The existence of a large direct-current component in a short-circuit current may cause a considerable reduction in the magnitude of the recovery voltage on some operations, but will not alter the operations of maximum severity which may occur with a given set-up.

The magnitude of recovery voltage as determined here is the value about which the high-frequency transients oscillate. The voltage may reach twice this value as the peak of a high-frequency oscillation.

Rate of rise of recovery voltage

The rate of rise of recovery voltage depends upon the electrostatic capacitance to neutral connected between the circuit breaker and the principal part of the reactance limiting the short-circuit current. Such capacitance may reside in any apparatus electrically connected to the system, but except in transmission lines and cables, and in rotating machines, it has a very low value. If the circuit breaker is separated from any of these by a current-limiting reactor, or a transformer, therefore, the recovery voltage is likely to rise at the rate of several thousand volts per microsecond. In the case of a short circuit at the generator terminals, if no transmission line or cable is connected between the generator and the circuit breaker, the rate of recovery voltage rise will usually be between 500 and 1,500 volts per microsecond, as shown by Fig. 2.

Transmission lines and cables rapidly reduce the rate of rise on buses to which they are connected. This is convincingly demonstrated by the curves of Fig. 3. Here curve 1 applies to a circuit breaker connected directly to the transformer terminals, with no bus structure and no tap lines, and the rate of recovery voltage is very high. In the case of curve 2, there is a transmission line 9.5 miles long between the circuit breaker and the point of short circuit. This reduces the short-circuit current and brings about a slight reduction in the rate of recovery voltage as a result, but the transmission line is not connected in the proper place to bring about a large reduction in the rate of recovery voltage rise. For that purpose it must be connected between the circuit breaker and the principal part of the reactance limiting the short-circuit current—in this case the transformer. The transmission line was so connected for curves 3 and 4, and the improvement is obvious from the curves. Actually, although the short-circuit current is twice as great in the case of curve 3 as for curve 2 the rate of recovery voltage is but one-fourth as great.

The rate of rise of recovery voltage is most conveniently calculated by dividing the magnitude by the time required to rise to this value. This time, in microseconds, is given roughly by the formula

$$t = 80 \quad xc = 10 \quad xl,$$

where x is the sixty-cycle reactance in ohms at the point of short circuit
c is the capacitance to ground in microfarads between the breaker and the principal part of the reactance limiting the short-circuit current, and
l is the length of overhead transmission line connected between the breaker and the principal part of the reactance limiting the short-circuit current.

This formula is sufficiently accurate to allow good prediction of breaker performance for a breaker whose characteristics are known.

Often the recovery voltage characteristic has two or more components of widely different frequencies. Curve 2 of Fig. 3 represents conditions on a high-voltage system.

Table II—Effect of Recovery Voltage on Breaker Performance

Line Voltage, Kilovolts	Transmission Lines Connected to Bus		Recovery Voltage Rate, Voltage per Microsecond	Maximum Current, Amp.	Maximum Arc Length, In Break	Maximum Arc Duration, Cycles	Maximum Over-all Breaker Time, Cycles
	No.	Miles					
140	3	218	270	4,900	6.0	3.25	5.75
140	1	22	600	3,600	9.1	4.75	7.0
140	0	0	2,400	5,300	14.5	5.5	7.75

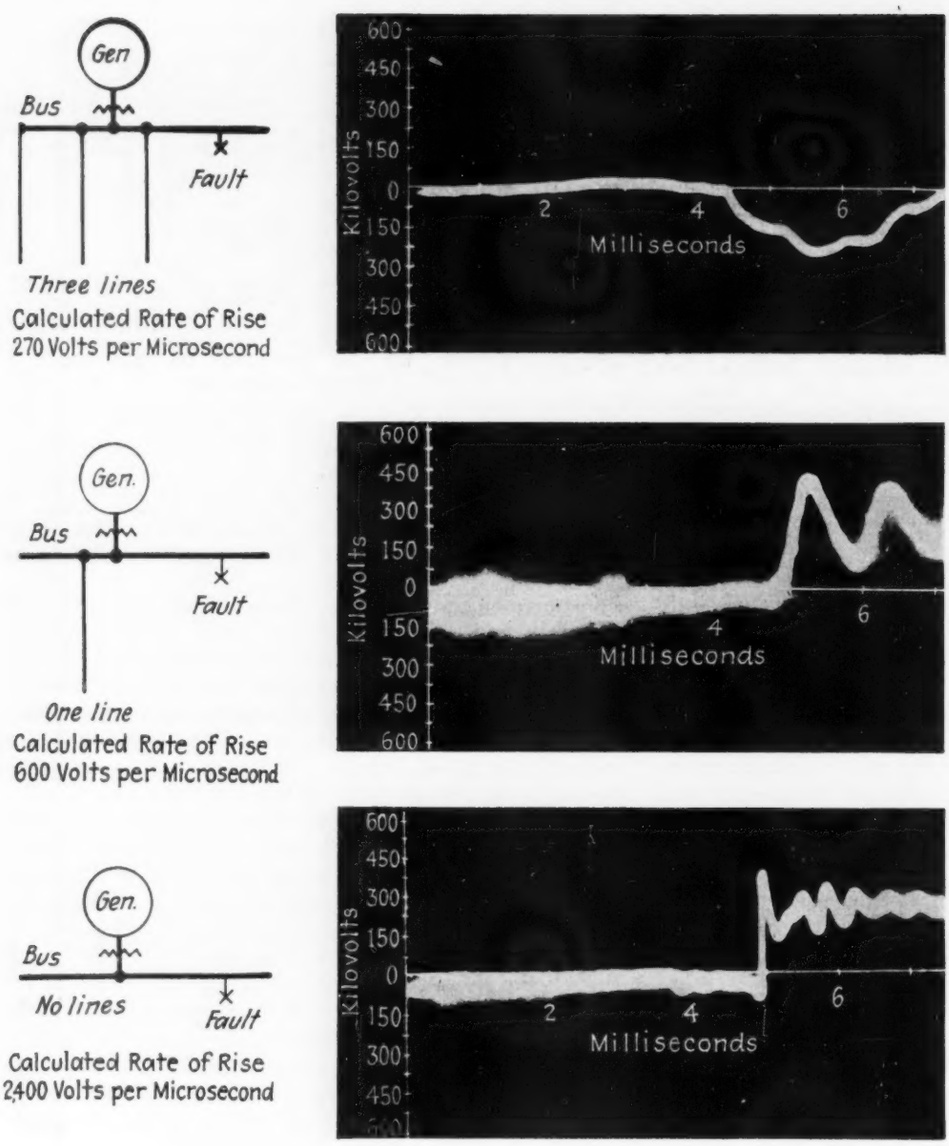


Fig. 4—Recovery voltage characteristics for Philo tests

A number of tests are on record proving that the performance of a breaker is affected by the recovery voltage rate.[1, 2, 3] Probably the most interesting of these are the tests made at 140 kv. on the system of the American Gas & Electric Company at the Philo plant. Here, in connection with high-power interrupting capacity tests, the recovery voltage rate was varied over a wide range by manipulation of the number of transmission lines connected at the energized terminal of the circuit breaker. It was thus possible to determine the effect of such variation upon the performance in the field of a breaker designed for operation on a high-tension transmission system.

Tests were made under three different conditions, as shown by Fig. 4. In the most favorable case three transmission lines, totaling approximately 220 miles in length, were connected to the bus from which the breaker was energized, giving a recovery voltage rate calculated as 270 volts per microsecond. In the second case, one line approximately 22 miles long was connected, giving a calculated recovery voltage rate of 600 volts per microsecond, and in the third case no lines were connected and the recovery voltage rate was calculated as 2,400 volts per microsecond. Cathode-ray oscillograms were obtained during an actual operation of the breaker at each of these connections, as shown in Fig. 4. The effect of these changes in the recovery voltage rate upon breaker performance is shown in Table II. It will be noted that by changing the recovery voltage rate the maximum arc length and arc duration were varied over a range of about two to one.

See footnote, page 1230.

[2] *Spurck and Strang, "Field Tests on Standard and Oil Blast Explosion Chamber Breaker," presented at the winter convention of the A.I.E.E., New York, N. Y., January 26-30, 1931.*

[3] *C. L. Denault, "Circuit Breaker Duty Affected by Speed," "Electrical World," November 15, 1930, Vol. 96, page 913.*

Diffusely Transmitting Media for Ultraviolet Radiation

By M. LUCKIESH

Director Lighting Research Laboratory
General Electric Company, Cleveland, Ohio

The design of lighting equipment for use with sources of ultraviolet radiation is greatly handicapped by the lack of media which will diffusely transmit both light and ultraviolet radiation. Since clear-fused quartz has a high transmission for ultraviolet radiation, it has been assumed that diffusing quartz, where the diffusion is obtained by making the body of the material porous, is also a good transmitter of ultraviolet. While it is undoubtedly superior to most of the other materials available, it is still rather inefficient for this purpose.

During the past few months we have tested many specimens of diffusing *Vitreosil* (fused quartz). Measurements of diffuse transmission for light and for ultra-

violet radiation have been made. The measurements of ultraviolet transmission were made by use of our blue-fluorescing attachment for the Macbeth illuminometer, using a sunlight "Mazda" lamp (S-1) as the source of ultraviolet radiation. This method of measurement approximately evaluates the transmitted radiation in terms of its erythemal effectiveness. Two specimens of pebbled-surface corex D glass were also measured in the same way.

Vitreosil	Approximate Thickness, Mm.	Diffuse Light	Transmission Ultraviolet
Practically clear	2.5	90	62
Practically clear, etched one side	2.5	80	45
Very slight diffusion	2.5	69	50
Very slight diffusion, etched one side	2.5	58	38
Diffusing, one side ground and polished, other side ground	1.5	46	32
Diffusing, one side ground and polished, other side ground	1.5	38	27
Diffusing, glazed two sides	2.5	45	19
Diffusing, one side glazed, one side rough ground	2	32	18
Diffusing, one side glazed, one side rough ground	3–4	27	12
Diffusing, one side glazed, one side rough ground	2.7	22	6
Diffusing, one side glazed, one side sand-blasted	3–3.5	25	11
Clear corex D, one side pebbled	1.8–2	92	73
Clear corex D, one side pebbled and sand-blasted	1.8–2	83	55

The fourth specimen in the above table represents approximately the least amount of diffusion that can be used satisfactorily with the sunlight "Mazda" lamp. The pebbled corex D, sand-blasted on one side, is about equally diffusing, but has transmission factors about 50 per cent greater for both light and ultraviolet. The pebbled corex D is available only in sheet form, but since this is a heat-resisting glass, practically free from solarization, it should be of great value in this field.

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READERS' FORUM

But It Has to Be Good Welding

To the Editor of the ELECTRICAL WORLD:

Your article in the May 23 issue entitled "Attitude of Eleven Utilities Toward Welded Boilers" has been read with much interest. I am very much impressed with the tenor of the responses, which rather definitely indicate that the large power boiler purchasers are favorably inclined toward welded boiler construction.

During the past few years the Hartford Steam Boiler Inspection & Insurance Company has been making extended investigations into the factors involved in making good welds and has evolved a method of procedure of its own which it is using until the more formal action of the Boiler Code Committee is definitely issued. The company is also engaged at present in an extended investigation of a lot of specially made test specimens that should represent a fair cross-section of good commercial welded work with a view to determining what practicable tests are best suited to assuring good work in the shop.

There is no question in my mind but that the next year or two will witness a very greatly extended use of this method of construction not only in boilers but in a very wide range of pressure vessels for a myriad of purposes.

In my opinion it is going to be very necessary to surround the practice of the welding art by shops with requirements of various kinds that will assure reasonably good work. There has been entirely too much criminally poor work done in the past which must be prevented in the future.

We are working in close touch with many of those who are most interested in this matter.

E. R. FISH,
Chief Engineer, Boiler Division.
Hartford Steam Boiler Inspection & Insurance Company,
Hartford, Conn.

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Large Lamps in Artistic Lighting

To the Editor of the ELECTRICAL WORLD:

James T. Holmes' comments in your issue of May 23, in reference to my recent article, are greatly appreciated, especially since he disagrees with me in regard to the use of special lamps.

His statement that lighting must be designed to produce the lighting effect which the architect wants is true. But the reason for special lamps lies in the fact that the architect does not tell the lighting man what he wants in time to obtain information about space requirements. An architect specifies many things, bricks, stones and window sash, door knobs, floor finish and bathroom facilities. But does the architect make up designs which require bathroom details of special dimensions? And is it necessary for the manufacturer of bathroom details to comprehend and visualize the whole architectural conception? The architect does make it necessary to use lamps of special dimensions and does compel the lighting man to comprehend and visualize the whole architectural conception, because he (the architect) knows a great deal more about bathroom details than he does about lighting.

The fault lies with the lighting man himself. He has been fawning too much to the architect. He has been worshiping too much at the architect's shrine. He has been singing too many hymns in the architect's praise. There are a few creative minds among the architects, a few men of genius and vision, and men who appreciate the trials and tribulations of the lighting man. These few men obtain very fine results in lighting because they consult the lighting man at the beginning of the development of the architectural idea. But the majority of architects are copyists; they know it all, they don't consult anybody, God bless them; some of them still base their lighting layouts on 16-cp. carbon lamps. Such architects are responsible for most of the bad lighting, and the sooner the lighting man stops fawning to them, the better.

In all this discussion about architects and lighting, or rather architects and lack of lighting, no one ever mentions the poor owner or occupant of the premises. He has to clean the fixtures; he has to renew the lamps; he has to pay the electric bill. And when a special lamp is burnt out he has to locate its specifications. When it is not in stock, he has to be in darkness for a while. Would it not be well to think less of the Buddha-architect and more of the user? Let us have more and larger standard lamps, let us have all the art we can get, but first of all, let there be more light!

M. M. SAMUELS,
Electrical Engineer.
302 West 90th Street,
New York City

BOOK REVIEWS

Patent Law for Chemists, Engineers and Executives

By F. M. Rhodes. McGraw-Hill Book Company, Inc., New York. 207 pages. Price, $2.50.

A broad understanding of patent law, of the requirements for patents and the rights granted by patents are given in this splendid book. It is working background for the engineer or executive interested in patents and gives valuable information for those dealing with patents.

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Commutatrices et Convertisseurs Rotatifs

By M. Barrère. J. B. Baillière et Fils, Paris, France. 492 pages, illustrated.

This book contains a quite complete treatment of synchronous converters. Following an interesting review of rectifying-commutator schemes, five chapters deal with the analytical theory and characteristics of converters in detail. The three final chapters are devoted to practical construction features. At the end of the book there are presented the design data of a number of modern converters of different makes, chiefly European.

Among the theoretical subjects covered are the analysis of the space and time variation of the converter magnetic fields, armature conductor heating, calculation of commutating poles, transients and short circuits, methods of voltage control, and some of the elements of converter design. The book is well illustrated with diagrams, curves, oscillograms and photographs of converters.

While this book appears to contain nothing that is radically new, it covers the generally accepted theory of converters clearly and in considerable detail, and so may be regarded as an excellent textbook on the subject.

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Die Neueren Fortschritte der Technischen Elektrolyse

By Jean Billiter. Wilhelm Knapp, Halle. 318 pages, 144 illustrations, 38 tables and twelve charts.

About 30 years ago, according to the preface, the author wrote a pioneer treatise on electrochemical processes in the heavy chemical industry. More recently a revision appeared under the title "Technical Electrochemistry." The new volume is to take into account subsequent changes, and so to serve as a supplement to its predecessor. Space has, therefore, been allotted largely on the basis of new developments rather than present commercial importance; that is why, for example, the electrolysis of beryllium salts gets more attention than the production of aluminum.

From this it is not to be inferred that the treatment is fragmentary; development has been rapid and widespread; its presentation therefore gives a fairly complete picture of the electrolytic technology of today. A glance through the index reveals the remarkable variety of processes that have arrived more or less at the commercial stage and that, judging by past experience, may either supplant older methods or introduce new products. Process charts afford a ready comparison of methods for copper, zinc and cadmium. The author is professor at the University of Vienna.

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Chemistry of Engineering Materials

By R. B. Leighou. Third edition. McGraw-Hill Book Company, Inc., New York. 684 pages, illustrated. Price, $4.50.

The author has revised and rewritten this splendid text to incorporate new developments. It covers water, fuels, refractories, metals, alloys, sands, stones, clay products, lubricants, paints, insulating materials, batteries and other common engineering products. While the treatment is from the point of view of chemistry, the scope is broad enough to cover complete characteristics of these products.

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Der Elektrische Heisswasserspeicher

By Dr. Ing. F. Kotsche and Dep. Ing. P. v. Entremont. Julius Springer, Berlin, Germany. 94 pages, 97 illustrations.

Domestic and commercial electric water heating is receiving its share of attention abroad as well as in the United States. Some 200,000 installations are now in use in Europe, according to a tabulation in this book. The preface states that the text originated in an effort to correct and prevent faulty installation which was causing disappointment. Consequently, there are details on selection, piping and tank construction, as well as on electrical wiring, control, metering and rates. The scope of the book is well summed up in the full title—"The Electric Hot Water Reservoir; Its Construction, with a Guide to Its Selection, Connection and Operation."

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The Psychology of the Inventor

A study of the patentee. By Joseph Rossman. Inventors Publishing Company, Washington, D. C. 252 pages. Price, $3.

A picture is given of the mental life of the inventor, why and how he invents, how he gets his inspirations, whether inventors are born or made, and other absorbing topics. Many facts are gathered and many observations of 710 prominent living inventors are quoted. Some of the important features of this book include the analysis of the mental operations of the inventor in terms of his own reactions and emotions; a description of the actual methods used by inventors; their trials and tribulations; their attitudes and opinions on the material side of inventing; their relation to the promoter and the purchasing public, and their experiences before the Patent Office and in litigation before the courts.

It is a comprehensive treatise on invention, touching upon all phases outside of the historical and legal. Much of the introductory material discusses accepted principles or well-known facts on the economic, legal and historical sides, but necessarily so to give basis for the superstructure forming the main body of the paper.

Dr. Joseph Rossman has had a legal, psychological and technical training which aptly fitted him to write this book. He is a patent examiner in the U. S. Patent Office, where he has made contacts with many inventors. He is a chemical engineer.

Men of the Industry

R. B. McWhorter Chief Engineer Federal Power Commission

ROGER B. MCWHORTER, of Alabama, has been chosen by the Federal Power Commission as its chief engineer. The appointment was made on the recommendation of Colonel Marcel Garsaud, who is the member of the commission in charge of its engineering activities.

Mr. McWhorter was called to New

Bachrach

Orleans in 1926 by Colonel Garsaud to act as the consulting engineer on flood control matters for the Orleans Levee Board. As a member of this staff he represented that body before the Board of Engineers which studied the use of spillways in connection with the plans for flood control on the lower Mississippi. Later Mr. McWhorter took an important part in the design and location of the Bonnet Garré spillway. He rendered an important service to New Orleans during the long period that flood control legislation was under consideration by committees of the House of Representatives and the Senate. From 1928 to 1930 he was retained by the Mississippi River Commission and stationed at New Orleans during the construction of the spillway.

Because of his experience in field investigations and because of his knowledge of the St. Lawrence project and of the situation in the Tennessee Valley, it is believed that Mr. McWhorter will be in a position to be particularly valuable to the Federal Power Commission. He is a native of Alabama and a graduate of the Alabama Polytechnic Institute. He served at Muscle Shoals during the construction period and since last September has been chief engineer of the Great Lakes division of the Corps of Engineers. He was one of the chief advisers of the engineering board appointed last year by the Governor of New York to prepare a report on the development of the power resources of the St. Lawrence River. Some years previously when a joint board composed of American and Canadian engineers prepared estimates of the costs of the St. Lawrence project, Mr. McWhorter was in charge of a portion of the work.

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P. M. Wentworth Assumes New Executive Duties

PHILIP M. WENTWORTH, for many years associated with the Stone & Webster organization in the management and supervision of electric, gas and transportation properties, has recently been elected a vice-president of the Stone & Webster Service Corporation with headquarters in Boston. In his new capacity he will sponsor the supervision of Fall River Gas Works Company, Fall River, Mass.; Edison Electric Illuminating Company of Brockton, Brockton, Mass.; Haverhill Gas Light Company, Haverhill, Mass.; Electric Light & Power Company of Abington and Rockland, North Abington, Mass.; Blackstone Valley Gas & Electric Company and the Pawtucket Gas Company, Pawtucket, R. I.

In 1910 Mr. Wentworth was graduated from the Massachusetts Institute of Technology and immediately became associated with Stone & Webster. In the course of this connection he has been identified with that company's properties in the West, New England, the South and Canada. During his connection with public utilities in the Southeast he served as a director of the Southeastern Division of the N.E.L.A.

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L. L. CRUMP, who was formerly connected with the Union Electric Light & Power Company of St. Louis, Mo., and the W. N. Matthews Corporation, has become associated with the James R. Kearney Corporation of St. Louis, Mo. Mr. Crump has had extensive experience as a distribution engineer and as engineer of material and construction specifications with the Union Electric Light & Power Company. He also served on the Midwest overhead systems committee of the N.E.L.A. in 1929 and 1930.

A. H. Kehoe Nominated as Engineering Section Chairman

ARTHUR H. KEHOE, electrical engineer with the United Electric Light & Power Company of New York, has been nominated for the chairmanship of the Engineering National Section of the National Electric Light Association. Mr. Kehoe has been identified with that organization since 1911, when he en-

tered the meter department. The following year he was transferred to the engineering department and after a period of two years was appointed engineer of distribution. In 1919 Mr. Kehoe assumed the duties of superintendent of transmission and distribution. Following this miscellaneous engineering work he became electrical engineer for the company in 1921, the position he occupies at the present time.

Mr. Kehoe received his technical training at the University of Vermont, from which he was graduated in 1911 as an electrical engineer. He spent a part of his vacation time with the Twin State Gas & Electric Company in the meter and inside construction departments. He is a member of the American Institute of Electrical Engineers and is an active participator in the affairs of the Engineering National Section of the National Electric Light Association.

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U. C. DUNAWAY, formerly connected with the public utility industry in the Middle West, has joined the live-line

tool department of James R. Kearney Corporation of St. Louis, Mo. Mr. Dunaway had been connected with the Central Illinois Public Service Company and the Missouri Gas & Electric Company in various capacities and more recently occupied the position of superintendent of overhead construction for the Kansas City Power & Light Company in the Kansas division. He is one of the pioneers in live-line maintenance work and in the course of his career has designed and made many live-line tools.

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MAURICE TAYLOR, welding technician for the Lincoln Electric Company, Cleveland, Ohio, sailed for Tokyo June 20 from San Francisco on the steamer *President McKinley*, where he expects to confer with officials in charge of ship construction for the Imperial Japanese Navy and supervise the installation of "Electronic Tornado" automatic welding machinery in the factory of the Kawasaki Company. Mr. Taylor plans to visit many manufacturing plants and engineers in the Far East using or considering the application of modern arc-welding methods to insure better construction and lower costs.

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ROGER W. ANDREWS, assistant to the president of the Blaw-Knox Company, has been appointed vice-president and a director of Blaw-Knox International Corporation. Mr. Andrews will reside in Paris and will be in charge of the company's European activities. Prior to Mr. Andrews' association with the Blaw-Knox Company he operated his own company under the name of Andrews-Bradshaw Company, specializing in power plant and engineering equipment. On January 1, 1928, the Andrews-Bradshaw Company was merged with the Blaw-Knox Company. Mr. Andrews is a member of the Engineers' Society of Western Pennsylvania and the A.S.M.E.

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DR. HARRIS J. RYAN, for the past 25 years head of the electrical engineering department of Stanford University, terminated his teaching career with the commencement exercises held June 15 and became emeritus professor of electrical engineering and honorary director of the high-voltage laboratory named in his honor. His retirement from academic routine will leave Dr. Ryan free to devote his entire efforts to electrical research, a prodigious amount of which he has carried on and directed during his 43 years as a teacher. In his honor a dinner tendered by the alumni of the department of electrical engineering of Stanford University was held at the San Francisco Engineers' Club Friday evening, June 19. Paul M. Downing, vice-president and general manager of the Pacific Gas & Electric Company, acted as toastmaster. Details of Dr. Ryan's distinguished career will be published in the next issue of the ELECTRICAL WORLD.

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F. J. Meyer Directs Operations of Oklahoma Utility

FRANK J. MEYER, who has been connected with the public utility industry in Oklahoma for a number of years, has recently been elected vice-president in charge of operation of the Oklahoma Gas & Electric Company. While studying physics and chemistry in high school he became interested in electricity

and decided to make engineering his life work.

In 1900 he began work as an apprentice with the Oklahoma Gas & Electric Company, continuing the study of electrical engineering through a correspondence school. He graduated from Pratt Institute of Technology, Brooklyn, N. Y., in 1906. After his graduation he went to Porto Rico as assistant electrician for the Guanica Centrale Sugar Company. After eighteen months there he returned to Oklahoma and again entered the employ of Oklahoma Gas & Electric Company as chief electrician. In 1906 he became superintendent of the gas department of this company.

During the World War Mr. Meyer resigned this position to serve as factory superintendent for the South West Manufacturing Company. In 1918 he returned to the Oklahoma Gas & Electric Company as electrical engineer and in 1920 he was made general superintendent. In 1924 he was appointed assistant to the general manager in charge of operation. Mr. Meyer is a member of the National Electric Light Association, American Association of Engineers and the American Institute of Electrical Engineers.

OBITUARY

H. E. CHUBBUCK, formerly executive vice-president in charge of the William B. McKinley Middle Western electric lighting and traction interests, who retired from active business eight years ago when the Studebaker interests assumed control of the properties, died suddenly, June 4, in his home in Peoria, Ill., at the age of 68. Mr. Chubbuck had been a resident of Peoria since 1910, removing to that city a few years after he had been identified with the McKinley properties, as general manager of the Illinois Traction System and the Western Railway & Light Company and their subsidiary companies. A year later he became executive vice-president, holding that position until his retirement. The grandson of Samuel Chubbuck and son of A. S. Chubbuck, pioneers in electrical development in the East, he began his career in the electrical field with the old Thomson-Houston Company. He was in charge of electric light plants in Pawtucket, R. I.; Syracuse and Auburn, N. Y., and Springfield, Ohio, and later reorganized the Omaha lighting system and after the 1893 panic took charge of reorganization of the street railway in Pueblo, Colo. Then he joined the McKinley interests, at that time launching a Middle Western utility which developed until it furnished electric light and power for 100 communities.

•

ALGER ADAMS CONGER, for the past two decades consulting hydraulic engineer of the New England Power Association and predecessor companies, died recently at his home in Wellesley Hills, Mass. Mr. Conger was born at Gouverneur, N. Y., in 1875, and after graduation from the Sibley College of Engineering at Cornell University in 1897 entered the service of the United States government. He was engaged in construction work at Panama, and later was employed upon the New York State Barge Canal undertaking and at Sault Ste. Marie in hydro-electric development. Joining the engineering organization headed by J. G. White, Mr. Conger as assistant hydraulic engineer had much to do with the pioneer development of the Connecticut River Transmission Company at Vernon, Vt., and in 1911, when the hydro-electric development of the Deerfield River was undertaken by the associated New England Power Company interests, he was taken into the engineering organization of the Power Construction Company as consultant. He was intimately concerned with all the subsequent hydro-electric developments of the system now included in the New England Power Association and was its senior consultant in this branch of engineering.

Financial and Statistical News

RADICALLY improved sentiment following international debt negotiations boosted utility common stock averages several points and was apparently a factor in renewed new financing which totaled more than $135,000,000 this week. Other large issues are said to be about ready for flotation, principally for refunding purposes.

——NEW FINANCING IS BEING CARRIED ON CURRENTLY at the lowest interest rates on record. A few 4 per cent issues have appeared, including that of Consolidated Gas of Baltimore, Public Service Electric & Gas and Commonwealth Edison Companies, the latter being sold to yield about 4¼ per cent. Seasoned utility bonds have strengthened considerably in the past few days.

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Commonwealth Edison Financing on 4 per Cent Basis

OFFERING WAS MADE of a new issue of first mortgage 4 per cent gold bonds, series F, of the Commonwealth Edison Company to the amount of $85,000,000, the price being 94½ and interest, yielding more than 4¼ per cent. Bonds totaling $59,774,000, bearing higher rates of interest, will be retired from the proceeds of this financing. Any unused balance of such proceeds will be applied to reimburse the company in part for capital expenditures heretofore made in the development of its properties.

Jersey Central Power & Light Company made an offering of first mortgage 30-year 4½ per cent gold bonds, series C, at 101 and accrued interest, to yield about 4.45 per cent, a piece of financing involving a total of $32,000,000. Proceeds from the sale of these first mortgage bonds together with the proceeds from the sale of preferred stock will be used in connection with the acquisition of the properties of new properties and for refunding purposes.

General and refunding mortgage gold bonds, series D, were issued by the Detroit Edison Company to the amount of $15,016,000 at 103½ and interest, yielding about 4.28 per cent, and the Houston Lighting & Power Company issued first lien and refunding mortgage gold bonds amounting to $4,500,000, at 98½ and interest.

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French Output Increases 10 per Cent

THE OFFICIAL REPORT of the French Ministry of Public Works on the output of electricity in France during 1929, which has lately been issued, shows that the aggregate production amounted to 14,327,000,000 kw.-hr., as compared with only 12,976,000,000 kw.-hr. in 1928, an increase of 1,351,000,000 kw.-hr., or just over 10 per cent. Of the total 8,202,000,000 kw.-hr. was produced by stations operated by steam or internal combustion engines and 6,125,000,000 kw.-hr. by hydro-electric plants.

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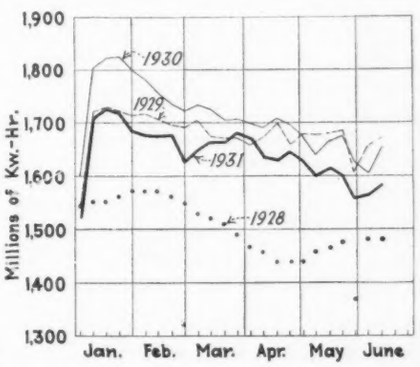
Weekly Energy Output

OUTPUT OF ELECTRIC light and power companies in the United States, as estimated by the satistical research department of the National Electric Light Association, is shown in the accompanying chart. For recent weeks and correspondingly in preceding years the energy generated was:



Week Ended	Millions of Kw.-Hr. 1931	1930	1929	1928
May 23	1,600	1,673	1,637	1,480
May 30	1,565	1,627	1,606	1,370
June 6	1,562	1,608	1,653	1,480
June 13	1,581	1,663	1,675	1,480
June 20	1,579	1,656	1,678	1,480

The decline from the output of 1930 increased to 4.9 per cent in the week ended June 13 and continues to be most severe in the central industrial region, where, in the same week, it rose to 8.3 per cent. From the Pacific Coast the unusually large decrease of 6.0 per cent was reported and along the Atlantic seaboard earlier gains have lately shown a tendency to be replaced by moderate losses.

For last week the per cent changes compared with 1930 (decrease shown by minus sign) in the Atlantic, Central and Pacific regions were respectively —1.4, —8.3 and —6.1.

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Emphasis Now on Transmission and Distribution

IN SPITE OF THE general business depression, the electric light and power industry in 1930 spent more on new construction than in any previous year. According to a bulletin of the statistical research department of the National Electric Light Association, reviewing the work of last year, the expenditures totaled $919,418,000, as compared with $853,000,000 during 1929.

The budget for 1931, it is stated, contemplates a total expenditure of $702,000,000. The decrease is ascribed to some extent to the price decline of materials and reduced construction costs. "The actual physical volume of new work more nearly approximates the general average of previous years than the figures would seem to indicate."

Of the total 1931 budget, 23½ per cent is allotted to generating facilities, 31½ per cent to transmission lines and substations, 33 per cent to distribution, and the balance, 12 per cent, to miscellaneous items. Of the proposed total of $164,000,000 for power plant construction, 66 per cent is to be applied to steam stations and 34 per cent to hydro-electric plants.

More than the usual mileage of transmission lines was placed in service last year, according to the bulletin. A total of 15,240 circuit-miles of line at 11,000 volts or more was constructed, bringing the total in service on December 31, 1930, to 200,171 miles. The 1929 line construction totaled 11,134 circuit-miles and the mileage for 1928 was 8,665. The increase in generating capacity, 2,491,000 kw., represents an average expenditure of $369 per kilowatt of increase as compared with $365 in 1929 and $387 in 1928.

"The large expenditure going into distribution shows that the electric light and power companies are engaged in extensive programs in building up and extending distribution facilities to take care of existing increased demands, to

provide for the much heavier demands anticipated and to improve the standards of service," says the bulletin.

"The heavy capital expenditures required to distribute electricity necessitate long-range planning of from five to ten years and systematic construction programs. The growth of the domestic load, indicating as it does uses per customer ten years hence of 1,000 to 2,000 kw.-hr. per annum, explains to a considerable extent these heavy expenditures now going into distribution plant."

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One per Cent of the Budget

DOMESTIC ELECTRIC SERVICE now stands at 69 per cent of its average price in 1913, the statistical research department of the National Electric Light Association reports. This is in direct contrast to practically everything else sold at retail which is still well above the 1913 level. In spite of its abrupt decline during the past twelve months, the composite figure for the "cost of living" today is at a level about 57 per cent above its 1913 figure. It is still 2½ times what it was in 1890. The price of electricity is now one-third of what it then was.

These electricity cost statistics exemplify the principle of lowered cost with increased use and greater diffusion of service. Electricity in the home today is 1 per cent of the total family budget.

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Municipal Rates Average Above Private Companies'

HAD THE PRIVATE COMPANIES collected as much per kilowatt-hour for electricity sold to their consumers in 1927 as did the municipal plants, their revenues from electric service would have been increased by $661,046,000, or 42.5 per cent. The actual revenue collected by the private companies was $1,554,606,537, out of which they paid $150,253,276 in taxes.

Conversely, had the light and power customers of the municipal plants paid for their energy at the average rate of the private companies, they would have saved $33,398,000, out of a total revenue of $112,439,034 shown by the census.

The preceding conclusions are drawn by the statistical research department of the National Electric Light Association from statistics published by the United States Bureau of the Census for 1927, the most recent census of the electric light and power industry.

The average revenue per kilowatt-hour of energy sold to ultimate consumers by private companies was 2.57 cents; the average for municipal systems was 3.66 cents; the average for all establishments, including both groups, was 2.62 cents. The same general rule is found to hold for the averages in indivual states with only two exceptions.

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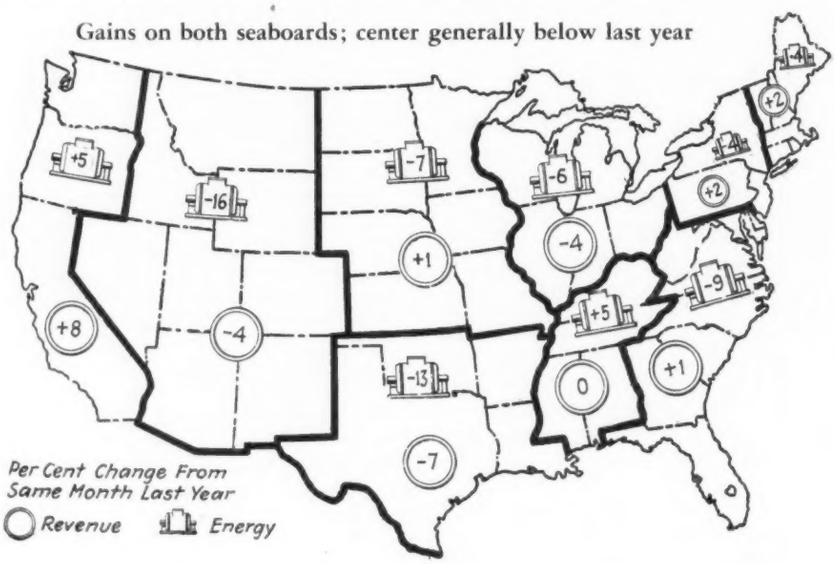
Further Progress Made in April

WITH an aggregate revenue in April of $176,370,000, operating expenses of $75,830,000 and an energy output of 7,202,597,000 kw.-hr. electric light and power operations in the United States compared more favorably with last year's record than in other recent months.

The month's revenue was a fraction of a per cent larger than in March, which in itself is somewhat unusual and brought the average daily revenue up nearly 4 per cent. Operating expenses and maintenance, on the contrary, fell off somewhat, according to the returns; while the output was less than in March, the decrease was so small that when account is taken of the difference in number of days the average was fully maintained; in fact, it rose a trifle, from 239,000,000 kw.-hr. per day to 240,000,000 kw.-hr. A decrease of 2 per cent would have been normal.

Gains on both seaboards; center generally below last year



In contrast with the preceding five months April revenue shows an increase over 1930, after a smaller decrease in March than in February.

How much significance is to be attached to the change from a relative decrease of 0.3 per cent in March to an increase of 0.2 per cent in the following month is a question that can better be answered when returns have been received for May. About 450,000,000

Table I—Central-Station Financial Operations in the United States

Compared with Corresponding Month of Previous Year

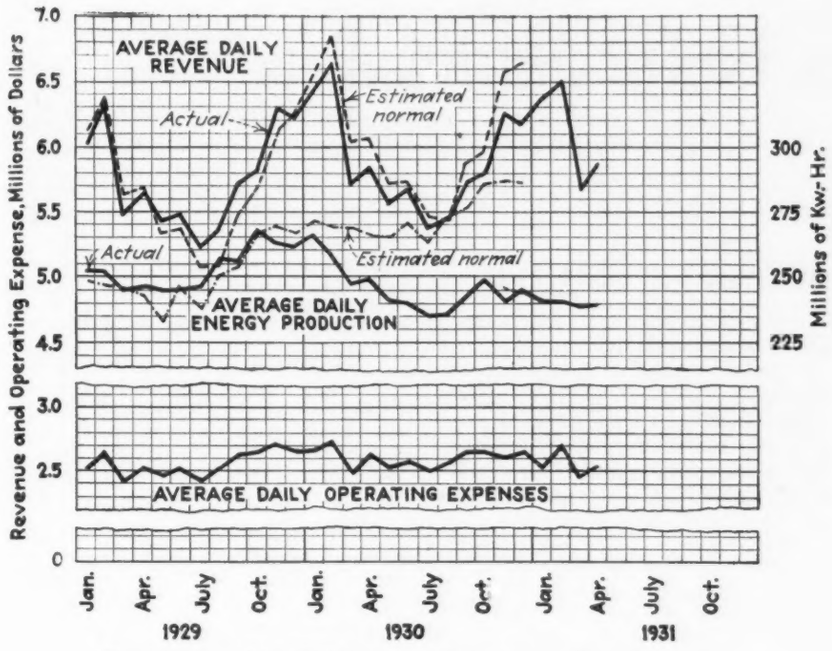
Month	Total Gross Revenue from Sale of Energy*			Total Operating and Maintenance Expense†		
	1931 Thousands	1931 Thousands	Per Cent Inc.	1931 Thousands	1931 Thousands	Per Cent Inc.
January	$196,970	$198,300	—0.7	$78,950	$81,480	—3.1
February	182,280	185,800	—1.9	75,820	77,300	—1.9
March	175,840	176,400	—0.3	76,500	77,200	—0.9
April	176,370	176,100	+0.2	75,830	78,300	—3.1

Table II—Central-Station Fuel Consumption in the United States‡

Compared with Corresponding Month of Previous Year

Month 1931	Coal		Oil		Gas	
	Short Tons	Per Cent Increase	Barrels	Per Cent Increase	Thousands Cubic Feet	Per Cent Increase
January	3,397,171	—7.8	777,857	—27.3	9,987,160	+1.8
February	3,022,123	—3.5	615,967	—8.8	9,113,266	—0.7
March	3,141,397	—0.5	623,976	+3.8	10,114,640	+8.4
April	2,731,665	—8.7	540,141	—3.6	9,559,612	+0.4

*Aggregate gross revenue from consumers and from other utilities for energy for resale, involving a certain amount of duplication.
†Do not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions. ‡As collected by U. S. Geological Survey.



Revenue regains 1930 level; spring output drop is absent

kw.-hr. more energy was generated from water power than in March, and 670,000,000 kw.-hr. less from fuel, which leaves a net decrease of 220,000,000 kw.-hr. Evidence of improvement in stream flow conditions is seen in the approach, within less than 5 per cent, of hydro-electric energy output to last year's figure, whereas in the first three months of 1931 it fell short by 20 per cent. Coal consumption decreased, almost 410,000 tons, to 2,731,665 tons, or 8.7 per cent less than it was a year ago. Oil and gas also decreased.

Regionally revenue was larger than in April, 1930, along the Atlantic seaboard and particularly in the Pacific states, while the central industrial region, the Southwest and the Rocky Mountain section fell short, as is apparent from Table IV and the map. Changes from last year in energy output and its apportionment between water and fuel power are due not only to changes in local demand but also to conditions making a transfer of energy advisable or necessary. New England hydro output rose 32 per cent.

Table III—Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1931	Generated, Thousands of Kw.-Hr.*						Purchased for Resale	
	Total		Hydro		Fuel			
	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Thous. Kw.-Hr.	Per Cent Inc.
January	7,487,204	—8.2	2,220,757	—20.4	5,266,447	—1.8	1,995,000	+12.5
February	6,750,223	—5.9	2,045,971	—20.8	4,704,252	+2.3	1,820,000	+11.7
March	7,422,721	—3.3	2,485,662	—19.3	4,937,059	+7.5	1,824,000	+9.7
April	7,202,597	—4.1	2,936,649	—4.7	4,265,948	—3.6	1,812,000	+9.0

Table IV—Regional Operations, Revenue and Energy Output in April, 1931

Compared with Corresponding Month of Previous Year

Region	Revenue		Energy Generated, Thousands of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.
United States	176,370	+0.2	7,202,597	—4.1	2,936,649	—4.7	4,265,948	—3.6
New England	17,700	+1.6	492,422	+4.1	302,033	+31.8	190,389	—21.9
Middle Atlantic	46,850	+1.8	1,707,728	—3.6	535,519	—8.7	1,172,209	—1.1
East North Central	42,820	—4.4	1,712,390	—6.4	174,931	—22.1	1,537,459	—4.2
West North Central	14,780	+1.2	447,498	—6.6	117,787	—13.3	329,711	—4.0
South Atlantic	19,640	+1.0	914,618	—9.3	579,432	—7.8	335,186	—11.5
East South Central	5,850	—0.1	316,760	+5.5	261,189	+3.6	55,571	+16.3
West South Central	8,730	—7.0	352,865	—12.8	9,177	+97.8	343,688	—14.0
Mountain	4,110	—3.9	244,848	—15.8	202,635	—19.7	42,213	+10.3
Pacific	15,890	+7.9	1,013,468	+4.7	753,946	—3.4	259,522	+38.6

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central-station operations.

NEWS BRIEFS

Stockholders of the National Public Service Corporation will meet July 6 to amend the certificate of incorporation to decrease the authorized shares of preferred stock, without nominal or par value, issuable in one or more series, from 170,000 shares thereto to 141,077 shares thereof and decrease the authorized shares of class B common stock, without nominal or par value, from 1,000,000 shares thereof to 985,500 shares thereof.

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Louisville Gas & Electric Company has been awarded an income tax credit and refund of $215,851, according to an announcement made by the Internal Revenue Bureau.

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Announcement has been made that Fred S. Burroughs, president of the Public Utility Holding Corporation, and George E. Devendorf, a vice-president and director of American Founders, Public Utility Holding Corporation and United States Electric Power Corporation, have been elected directors of the American Commonwealths Power Corporation. This step represents the entry of Chase-Harris, Forbes interests into American Commonwealths.

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Board of directors of the Standard Gas & Electric Company has elected a finance committee composed of B. W. Lynch, chairman; Robert J. Graf, J. H. Briggs, Louis H. Seagrave and Victor Emanuel.

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Alaska, Hawaii and Guam

POWER PLANTS IN Alaska, Hawaii and Guam are listed in Special Circular No. 605, recently issued by the Bureau of Foreign and Domestic Commerce and superseding the circular dated December 12, 1930, a notice of which appeared in the February 7, 1931, issue of ELECTRICAL WORLD.

The report lists seventeen communities in Alaska, five of which receive energy at wholesale; nine power plants generate the supply of electricity which is used in the twenty-six communities listed for Hawaii. The Island of Guam is served by a single United States Government plant.

In addition to the names of the companies in the communities served by each, the circular gives the installed capacity and class of plant, the type, phase, cycle and voltage at which current is distributed and indicates whether ownership of the generating plant or distributing system is private or public.

Business News and Markets

Refrigeration Division Convenes in Detroit

THE refrigeration division of the National Electrical Manufacturers' Association and its committees held their May meeting on the 27th at the Kelvinator plant, Detroit. C. E. Greenwood, commercial director of the National Electric Light Association, outlined the organization and activities of the electric refrigeration bureau of N.E.L.A. and detailed its progress to date. The division members were urged to acquaint themselves more fully with the accomplishments and possibilities of the bureau and become affiliated with the movement.

Mr. Cockrell, president of the *Electric Refrigeration News*, discussed the value of industry statistics and urged the division to solicit the co-operation of non-member companies in this activity.

The chairman of the technical committee, H. M. Williams, reported the development of a proposed method of testing domestic equipment. The method is in trial operation by several of the members and it is the committee's opinion that it will be able to make specific recommendations to the division within the next 60 days.

Preliminary work on the standardization of rating of commercial machines will be started at the next committee meeting.

Col. F. E. Smith, chairman of the commercial practices committee, reported that considerable progress has been made in the consideration of a recommended uniform warranty and the committee feels that specific proposals will be developed for presentation to the division at its next meeting. He also stated that the subcommittee on patents reported as its unanimous recommendation that all matters of infringement be taken up directly with the manufacturers involved and not with individual dealers, distributors or purchasers.

Carl D. Taylor, chairman of the industrial research committee, reported that his committee recommended active co-operation with the quick-frozen food interests. It was the consensus of the division that the recommendation be held pending further investigation. The division requested that the managing director of N.E.M.A. contact the executive heads of leading producers of quick-frozen foods to ascertain the reaction to the refrigeration division taking the initiative in frozen-food activities.

The chairman called attention to the division's action of April 22 empowering the advisory committee to recommend the selection of a man whose duty will be the promulgation of the A.S.A. refrigeration code. The committee reported its selection of Glenn Muffly and the concurrence therein of the managing director of N.E.M.A.

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1,000,000,000 Lb. of Copper for Britain

PLANS FOR ELECTRIFICATION of the British railroads under Lord Weir's scheme forecast a huge outlet for copper, according to the Copper and Brass Research Association. The program now under discussion would require 1,000,000,000 lb. of copper.

	Pounds
Generation and transmission	80,000,000
Conversion	30,000,000
Distribution and contact	660,000,000
Auxiliary feeder	35,000,000
Equipment	170,000,000
Signals and auxiliary power	25,000,000
Total	1,000,000,000

The Weir plan calls for electrification of all British main lines involving a total route mileage of 20,300, main track mileage of 36,000 and an additional 15,500 miles of sidings. Total net outlay is estimated at $1,300,000,000. According to the study by the Copper and Brass Research Association the copper requirements for the project would be distributed as shown in the accompanying table.

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New Measurements for Western Red Cedar Poles

A SPECIAL SUBCOMMITTEE of the sectional committee on wood poles of the American Standards Association developed a new table of measurements for Western red cedar poles in accordance with the following principles:

Ten size classes numbered from 1 to 10 were established. All dimensions in each pole length were stated in terms of circumference in inches.

Classes 1 to 7 inclusive were given minimum top, and 6 ft. from butt, circumference dimensions; classes 8, 9, 10 top dimensions only.

Dimensions for classes 1 to 7, inclusive, were designed to meet the following breaking loads, conservatively rated for the minimum size pole in any given length and class: Class 1, 4,500; 2, 3,700; 3, 3,000; 4, 2,400; 5, 1,900; 6, 1,500; 7, 1,200.

No breaking loads were assigned to classes 8, 9, 10.

Breaking loads were converted into moments of resistance at the ground line. (Lever arm length equivalent to distance from ground line to 2 ft. from top of pole.)

The required ground line circumferences were calculated by using beam formula $Mr = 0.000264fC^3$. Mr is moment of resistance, f is the standard fiber stress of 5,600, C is circumference in inches.

Actual ground line circumferences were converted into 6 ft. from butt circumferences by the use of a predetermined average taper factor.

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DELINQUENT ELECTRICAL ACCOUNTS

(National Electrical Credit Association)

Number of Accounts Reported

Division	May 1930	May 1931	Per Cent Inc. or Dec.	Five Months 1930	Five Months 1931	Per Cent Inc or Dec.
New York	322	199	—38.2	1,649	1,360	—17.5
Middle & Southern Atlantic	128	133	+ 3.9	929	666	—28.3
New England	138	69	—50.0	704	460	—34.7
Central Division	861	540	—37.3	4,142	3,178	—23.3
Total	1,449	941	—35.0	7,424	5,664	—23.7

Total Amounts Reported

	May 1930	May 1931	Per Cent Inc. or Dec.	Five Months 1930	Five Months 1931	Per Cent Inc. or Dec.
New York	$47,812	$23,282	—51.3	$285,351	$170,789	—40.1
Middle & Southern Atlantic	31,303	11,830	—62.2	149,717	83,377	—44.3
New England	22,929	7,538	—67.1	110,266	43,340	—60.7
Central	112,957	48,682	—57.0	582,725	290,121	—50.2
Total	$215,001	$91,332	—57.5	$1,128,059	$587,627	—47.9

Westinghouse Continues Four-Dollar Dividend

FOLLOWING THE MEETING of the board of directors of Westinghouse Electric & Manufacturing Company the following statement was issued by A. W. Robertson, chairman:

Although the earnings for April and May of the second quarter were not sufficient to cover the dividend requirements of the company, yet they were so far improved as to show a small profit as compared with the loss of the three preceding months. It was the opinion of the directors that, considering the fine cash position of the company and the substantial surplus which has been accumulated over the past years and not distributed to the stockholders, dividends should be declared. Accordingly, a dividend of 2 per cent ($1 per share) on the preferred stock was declared for the quarter ending June 30, 1931, payable July 31, 1931, to stock of record July 6, 1931, and a dividend of 2 per cent ($1 per share) on the common stock was declared for the quarter ending June 30, 1931, payable July 31, 1931, to stock of record July 6, 1931.

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Copper or Aluminum for New York Power Line?

WILL COPPER OR ALUMINUM be used to construct the southern section of the high-tension power line which will tie in Niagara Hudson Power system with the New York Edison Company? A special engineering committee has been conducting a survey to determine which is most suitable from various angles.

The chief advantages of copper over aluminum are cost considerations. It is understood, however, that aluminum manufacturers are willing to meet the copper prices in order to get the utility business. Aluminum has been a serious competitor of copper recently for a transmission and distribution line material.

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TRADE BRIEFS

James R. Kearney Corporation announces that S. Bingham Hood has been appointed development and research engineer and that H. H. Manny is associated with its Pacific Coast representative, Maydwell & Hartzell, Inc.

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The American Askania Corporation, Houston, Tex., has recently opened a new office with service facilities and displays in Chicago, Ill.

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Atlanta, Ga., sales offices of Cutler-Hammer, Inc., are located at 133 Cone Street, N.W. These new quarters also include warehouse facilities, where a stock of the motor control, wiring device and safety switch items will be carried for immediate delivery. A. C. Gibson is manager of the Atlanta district.

Monarch Machine Tool Company of Sidney, Ohio, has opened an office in Chicago, located at 547 West Washington Boulevard.

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Electrical Manufacturing Shows Slight Change

SLIGHTLY less activity in electrical manufacturing is shown by May returns on energy consumption in that industry than by those for April, the decrease being about 3 per cent after adjustments for the number of working days. The change parallels what happened a year ago, the index standing 16 per cent lower than in May, 1930.

Comparative Index Numbers

May, 1931	132.0
April, 1931	136.7
March, 1931	124.3
February, 1931	149.0
January, 1931	144.7
May, 1930	158.0
April, 1930	164.9
Average first five months, 1931	137.3
Average first five months, 1930	159.5

almost as was the case in April. The present level is close to that of December, 1930. For the first five months the average for 1931 is 14 per cent below that for 1930.

Compared with conditions last winter Eastern plants are, on the whole, a little less active while the Middle West shows a gain, in which the manufacture of appliances seems to have had considerable influence.

Despite the decrease, electrical manufacturing, gaged by energy consumption, continued to do better than a number of other industry groups, the latest index being only 27 per cent below that for the peak month in its history, when it climbed to 180.6. For comparison, the corresponding drop in the weighted index for all industry was 22 per cent, in iron and steel manufacture 38 per cent, in metal-working plants 29 per cent, in the manufacture of automobiles, parts and accessories 47 per cent. In each instance electrical energy consumption of a considerable number of representative establishments is here used as the measure of industrial activity.

The accompanying table gives certain comparable index numbers for electrical manufacturing.

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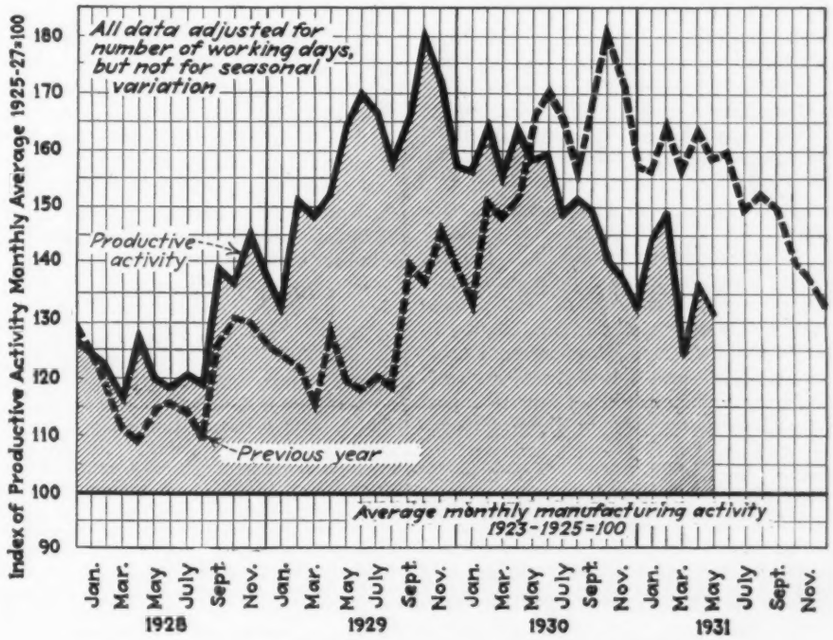
New York Metal Prices

	June 17, 1931 Cents per Pound	June 24, 1931 Cents per Pound
Copper, electrolytic	8	8.50
Lead, Am. S. & R. price	3.75	4.25
Antimony	6.05	6.25
Nickel, ingot	35	35
Zinc, spot	3.65	3.85
Tin, Straits	22.70	22.20
Aluminum, 99 per cent.	23.30	23.30



Barometer of productive activity in the electrical manufacturing plants of the United States

Market Conditions

DEBT moratorium discussions seem to have revived equipment markets in the Eastern district, as has been the case in securities markets the world over. Central-station, industrial and railroad business all appear to feel the impetus. Sentiment is decidedly better in the equipment business on the West coast, but orders are still limited, especially for appliances. Small orders are assuming large proportions in the aggregate in the North Pacific area. ——SOME IMPROVEMENT IN VOLUME OF ORDERS AND INQUIRIES is noted in the Southeast district, but orders are individually small.

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PACIFIC COAST

—ELECTRICAL BUSINESS PRESENTS *the paradox of being very brisk in every respect except that of orders. Machinery manufacturers report a larger number of open negotiations now than at any time since June, 1930, and that many staples, especially small distributing transformers, are rapidly approaching normal demand.*

—THE MARKET TONE *is more cheerful, though manufacturers of industrial equipment are complaining that stock orders, the usual backbone of their business, are still very small, and that most orders cover particular jobs.*

The San Francisco bay area is on the threshold of excellent business. Electrical work is pending on $6,000,000 worth of jobs, including the Golden Gate bridge contract, which is close to $150,000 itself for the lighting, control and signal apparatus. Railroad business includes awards on the basis of staple requirements for the coming three months and railroad men predict early improvement. Small industrial buildings, a $250,000 factory here, a $400,000 plant there, are beginning to crop up again, and they are well scattered.

Business includes a 25-light job for Courtland, 25 duplex lights for San Jose, one-half carload of No. 2 and No. 4/0 bare copper wire and 20,000 ft. of No. 4/0 to No. 6 lead-covered cable for Glendale and a Los Angeles street-lighting job. Lighting men report considerable activity in lighting playgrounds and stadia and a renewed interest in floodlighting of commercial structures. Copper prices are a little weaker, but prices in other lines, despite quantity adjustments to meet prevailing hand-to-mouth buying, are fairly strong and credits are holding up well.

With rail orders coming in slowly and cargo shipments light no uptrend in the lumber market in the immediate future can be visualized by Northwest lumber manufacturers. Logging camps are inactive, generally speaking, and the major portion of concerns operating plan to shut down form a week to a month or more starting with the fourth of July holiday. Motor movement to these sources is at a minimum, buying being only for replacements. The only apparatus order of consequence placed last week was that of the Puget Sound Power & Light Company for a 15,000-kw. synchronous condenser for installation at Beverly Park near Everett, the award, involving about $125,000, being given to Westinghouse. Miscellaneous switchgear sales involving less than $2,500 have been reported made.

Motor sales included twenty machines from 15 hp. down to a dealer in the agricultural district, 35 machines from 25 hp. down to dealers and miscellaneous industrials, fifteen machines, including three 60's, to a pulp and paper mill and sawmills and about 45 machines from 50 hp. down, the majority 20 hp. and under, to pulp and paper mills and miscellaneus sources. City of Seattle bought 3,500 lb. of ¾-in. friction tape and 12,000 ft. of underground lead-covered cable. Construction of a pulp and paper mill, sawmill, creosoting and veneer plant at Port Renfrew, B. C., estimated to cost between $6,000,000 and $8,000,000, is planned by the Lone Star Timber Company, Seattle.

CONSTRUCTION PROJECTS

California Institute of Technology, Pasadena, Calif., has approved plans for two engineering and laboratory buildings to cost $500,000, with equipment. United States Potash Company, operated by the Pacific Coast Borax Company, Los Angeles, Calif., plans potash refining plant near Loving Station, Eddy County, N. M., to cost over $500,000. American Smelting & Refining Company, Salt Lake City, Utah, plans installation of tramway system at mines at American Fork, Utah. Colorado Fuel & Iron Company, Pueblo, Colo., will carry out an improvement program at Minnequa plant to cost about $200,000. Treasury Department, Washington, D. C., has plans under way for a multi-story federal building at Phoenix, Ariz., to cost over $1,000,000.

SOUTHWEST

—BUSINESS DURING *the past week has shown no material change, manufacturers report. The demand for smaller sizes of apparatus is steady, but still running in small orders.*

No contracts were made for machinery of any size, although three orders are said to be ready to close. Several inquiries have been received from southern Missouri and Arkansas for motors and transformers to be used in cotton gins.

CONSTRUCTION PROJECTS

William Rockhill Nelson Trust, Kansas City, Mo., will install a power plant in connection with an art gallery and museum of fine art, entire project to cost $1,000,000. Kansas City Southern Railroad Company, Kansas City, Mo., will soon take bids for a grain elevator to cost about $125,000. Atchison, Topeka & Santa Fe Railway Company, Chicago, Ill., is completing plans for a passenger and freight station at Oklahoma City, Okla., to cost $500,000. Texas Agricultural and Mechanical College, College Station, Tex., plans agricultural engineering and chemistry building to cost $500,000.

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SOUTHEAST

—A FAIRLY WELL SUSTAINED VOLUME *of orders and inquiries is reported for the Southeast, for motors particularly, the cotton gin type coming in for some attention. A Georgia central station placed three orders last week for paper cable aggregating in excess of $60,000, while a Florida company ordered switching equipment amounting to 18,000.*

An order for transformers and lighting equipment totaling $7,000 was placed with a concern in this section for use in a veterans' hospital outside this territory, a Georgia company's pole line hardware orders last week aggregated $5,050, a Florida industrial placed orders for motors and crusher equipment amounting to approximately $20,000 and the coal and iron interests in the Birmingham district were responsible last week for an order for nineteen direct-current motors and a 1,000-hp. synchronous motor, these orders totaling $20,000. Approximately $25,000 worth of wiring supplies are expected to be ordered this week for a new mill going up in Georgia.

CONSTRUCTION PROJECTS

Holston River Power Company, Johnson City, Tenn., plans construction of power dam on South Fork of Holston River, Washington County, Va., for proposed hydro-electric generating plant with capacity of 24,000 hp. Adams-Millis Corporation, High Point, N. C., will build an addi-

tion to hosiery mill to cost close to $100,000. Brown Guano Company, Albany, Ga., plans extensions and improvements in fertilizer plant to cost over $250,000.

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EASTERN

—PRESIDENT HOOVER'S PROPOSAL *for a moratorium on war debts and reparations to assist in bringing conditions back to normal seems to have had its effect on the electrical equipment market in the Eastern district just as it has inspired other branches of trade and finance. The week has rounded out with an improved business tone, reflected in some substantial commitments for central station and other account, with railway electrification recording its share.*

—A PENDING AWARD *by the Navy Department for electrical machinery for three battleships is bringing interest in that quarter, while other government call continues to inspire active bidding on the part of manufacturers. The outlook for wire and cable is better than for several weeks past.*

A power company in Iowa has ordered a turbine unit from a New York manufacturer, totaling $170,000. A Mississippi municipality has contracted with a Philadelphia maker for a Diesel engine unit for municipal station service. Another city in Mississippi has divided an order for equipment for a similar purpose between the General Electric Company and Westinghouse Electric & Manufacturing Company, with commitment for a water-tube boiler unit going to the Babcock & Wilcox Company.

The Big Four Railroad, operated as a part of the New York Central Lines, has placed an order with the J. G. Brill Company, Philadelphia, Pa., for two gas-electric rail cars, each to cost about $80,000. The Pennsylvania Railroad Company has closed bids for a quantity of aluminum cable for use in connection with the electrification of its lines between Newark and Trenton, N. J., about 60 miles, now under way, and will make an award at an early date; heretofore, copper has been the popular material for feeder lines of this kind and the use of aluminum on the Pennsylvania system is an interesting departure. Following recent contract for electrical equipment for 90 locomotives to be used on the lines, the Pennsylvania company has allotted orders for the mechanical construction of the locomotive units, 54 to be built by the Westinghouse company at Eddystone, Pa., and for which it will furnish all electrical equipment, 25 to be constructed by the General Electric Company at its Erie, Pa., works, and eleven to be built at the Altoona, Pa., shops of the Pennsylvania Railroad, all electrical equipment for the 36 locomotives to be of General Electric type.

CONSTRUCTION PROJECTS

American Locomotive Company, New York, plans extensions and improvements in plant at Schenectady, N. Y., to cost over $200,000. Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until July 2 for 5,200 ft. of lighting and power cable for New York harbor (Schedule 5927). Yonkers Statesman Corporation, Yonkers, N. Y., has filed plans for a newspaper printing and publishing plant to cost $250,000. Aplo Clothing Company, New Brunswick, N. J., plans plant addition to cost $125,000. General Purchasing Officer, Panama Canal, Washington, D. C., will receive bids until July 6 for 87,500 ft. of telephone distribution cable, loading coils, etc. (Schedule 2664).

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MIDDLE WEST

—NOT MUCH CHANGE *in general business conditions is observed this week in the Middle West section. A growing optimistic sentiment is more apparent and the number of favorable indications are increasing from week to week. The volume of business appears substantially the same and the month is expected to close well.*

—WHILE GENERAL CAR LOADINGS *are expected to decline from the previous week's figures, several of the railroads in this section show an appreciable increase in revenue freight loadings.*

The major activities, with the exception of the steel industry, which has receded to a new low, are in much the same position as last week. The recent advance in metal prices has had a beneficial effect, if only psychological. The various utility companies are proceeding normally with as much construction work as possible and with apparatus running into the millions of dollars on inquiry at this time. Some of the interesting orders placed this week include construction of a 66-kv. high-tension transmission terminal superstructure to cost approximately $60,000, control cable valued at $18,000, 50 control relays for oil circuit breakers, 60 self-cooled 25-kv. outdoor potheads and "Mazda" lamps valued at $150,000.

CONSTRUCTION PROJECTS

Buhl Aircraft Company, Marysville, Mich., contemplates plant at St. Clair, Mich., to cost over $100,000. Detroit Public Lighting Commission, Detroit, Mich., plans power substation to cost $50,000. Archer-Daniels-Midland Company, Minneapolis, Minn., plans grain elevator to cost close to $1,500,000. Madison Light & Power Company, Madison, Ind., has applied for permission to make extensions in transmission lines in rural districts. Gulf Refining Company, Pittsburgh, Pa., has plans for a bulk oil storage and distributing plant at Cleveland, Ohio, to cost about $250,000. Winona, Minn., will receive bids until July 14 for one automatic coal stoker. State College, Brookings, S. D., will receive bids until July 7 for equipment for addition to power plant, including stoker, draft fans, etc. Treasury Department, Washington, D. C., has authorized plans for a federal building and post office at Sioux City, Iowa, to cost $1,000,000.

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NEW ENGLAND

—NEW ENGLAND ELECTRICAL MATERIAL *sales displayed fresh vitality this week, with gradual improvement in business conditions. Inquiries for line material and wiring increased in response to price advances in copper and hardware following betterment in commodity markets immediately after President Hoover's international debt moratorium proposal. Small steam turbine negotiations for industrial and central station auxiliary service are very active.*

A 5,000-kw. hydro-generating unit was sold to a Bangor company and 5,000-kva. synchronous condenser to the Tenney company at Concord, N. H. Two carloads of fiber conduit was sold for utility construction by one jobber. Bridgeport purchased a 12,500-kva. steam turbo-generator for the Steel Point station. Massachusetts state institutions are buying considerable wiring material. New England motor sales are improving and in general are ahead of those in other sections in percentage of normal. It is expected that the reduced volume of motor sales compared with last year will be overcome by mid-fall. Industrial electrical buying is also improving. Range and refrigerator sales are piling up records. New building construction includes $300,000 for Lawrence schools, $650,000 for a Dorchester school and $175,000 for a Falmouth school, $200,000 for a new hotel at Lynn, $60,000 for a post office at Winthrop, and $75,000 for a post office at Hallowell, Me.; $60,000 for an armory at Claremont, N. H.; $700,000 for a Boston hospital, $80,000 for an appartment building and $60,000 for railway power station alterations at Boston, also $200,000 for an almshouse at West Stewartson, N. H.

CONSTRUCTION PROJECTS

Boston Consolidated Gas Company, Boston, Mass., plans equipment storage and distributing plant, with meter department, service division, etc., at Jamaica Plain, to cost over $200,000. Whitehead Metal Products Company, Boston, Mass., has plans for a multi-story plant to be occupied under lease, estimated to cost more than $175,000. Board of Education, Springfield, Mass., has plans for a technical high school to cost $400,000.

New Equipment Available

Time Meter Checks Piece-Rate Operations

THE ACTUAL OPERATING TIME of any a.c. equipment is shown by a time meter placed on the market by the General Electric Company. Within the meter is a synchronous motor, like that used in a General Electric "Telechron" clock, which operates while the circuit of the equipment is closed. This motor, through suitable gearing, drives a cyclometer five-digit counter, arranged to read in either hours or minutes.

Such a meter is valuable in checking piece-rate operations, particularly when idle-time credit is allowed in computing wages. A weekly reading of the meter shows how many hours the machine was in operation, and hence, by deduction, the number of idle hours. Other applications to which the meter can be applied include checking on the amount of time electric refrigerator mechanisms are in operation and in making life tests of radio and other vacuum tubes, incandescent lamps, etc.

The meter is supplied on a pedestal for portable use or with a threaded connection for permanent mounting on conduit. The meters are available for 110, 220 or 440 volts and for 25, 50 or 60 cycles, but no one device has more than one voltage or frequency rating.

▼

AS A MEANS OF SUPPLYING NOISELESS, non-pulsating d.c. power from the ordinary a.c. line, the Square D Company announces a power filter unit. It differs from the ordinary rectifiers for keeping operating batteries charged, since without auxiliary equipment it can supply clear, pure d.c. from a.c. supply. It has no moving parts. This unit is recommended also to manufacturers of magnetic chucks for industrial work where it will supply a pure d.c. current without the attendant nuisance of constant maintenance of motor-generator sets and with considerable saving of space.

▼

Tap Changer for Small Distribution Transformers

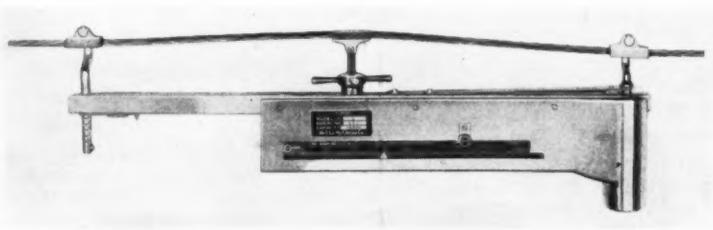
A TAP CHANGER for transformers in the following classes, 6,900/11,950Y volts, 7,620/13,200Y volts, 11,000 volts and 13,200 volts, has been put on the market by the Allis-Chalmers Manufacturing Company, Pittsburgh, Pa. This will be supplied in transformers 15 kva. and larger up to and including 200 kva.

The tap changer mechanism is a simple device. It consists of a tube of "Fibroc" having six equally spaced contacts riveted rigidly to the tube. An adjustable cylinder carrying a contactor shoe slides up and down in the tube. A small pin fits into guide slots in the top of the cylinder, which centers the cylinder in the tube so that proper contact position is obtained. An aluminum dial carries embossed letters A, B, C, D and E and the operating handle carries a pointer which indicates the tap point. The entire mechanism is mounted on a substantial steel ring to which the supporting clip is electrically welded.

▼

Records Wire Tension Up to 16,000 Lb.

A NEWLY DESIGNED "TENSIOMETER" for recording the tension on wires, cables and lines quickly and accurately is announced by the Hills-McCanna Company, Chicago. Weighing only 14 lb. the "Tensiometer" has an over-all dimension of only 2½ ft., which enables easy handling and uses in many positions.



The standard model will test all wires and ropes up to 1 in. in diameter and has a tension capacity of 16,000 lb. Larger capacity meters and meters for special shaped stream line airplane cables can be supplied. The instrument is very sensitive and will register the slightest change of tension.

The "Tensiometer" is simply hooked onto the wire in any position and the center bearing tightened, which deflects the cable. A correct reading is given at once. The reading is taken directly from the scale in pounds. There are no liquids, glass or loose parts.

▼

New Features Added to Ultraviolet Lamp

FOLLOWING THE INTRODUCTION of the type S "Mazda" lamp in 1929 the General Electric Company has announced three new types, designated S-2, G-1 and CX. The S-2 lamp is basically similar to the type S lamp, with new features including increase in the arc length and the addition of a metal cap to the lower portion of the bulb to redirect energy back into the mercury vapor and light source area. The lamp starts at 30 volts, 2 amp., and operates to 15 volts, 8½ amp.

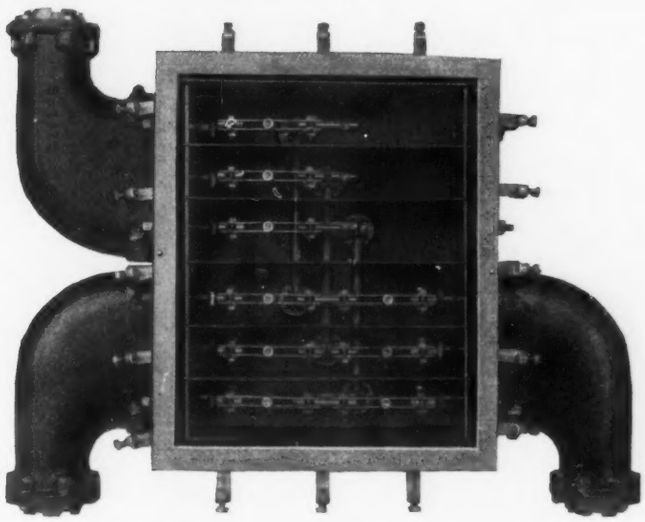
Type G-1, the glow lamp, consists of two heater filaments called cathodes, a connecting and supporting bridge, and center support to hold them, and a pool of mercury. It starts on a current of 2 amp. at 35 volts and operates at 20 volts, 2 amp. and consumes approximately 40 watts.

The CX lamp is especially adapted to poultry raising. It is made up in 60 and 500 watts, and in voltages of 110, 115, 120, for a.c. or d.c. lighting circuits.

▼

INSULATING MATERIAL known as "Dilecto K-4" is being produced by the Continental-Diamond Fibre Company, Newark, Del. In addition to high electrical insulating properties, "Dilecto K-4" has high thermal insulating efficiency, is odorless and does not attract odors, it is claimed. It is also highly resistant to alkali solutions and to water moisture. The material is made in sheets, rods and tubes. It can be machined readily.

Standardize On G&W Boxes, Too



economy now

and

for years to come

A multitude of shapes, styles, and sizes can be assembled to exactly fit your job —with standard interchangeable parts

STANDARDIZE ON G&W

YOU can save much time, effort and expense. Orders, reorders, repairs and changes are made with ease.

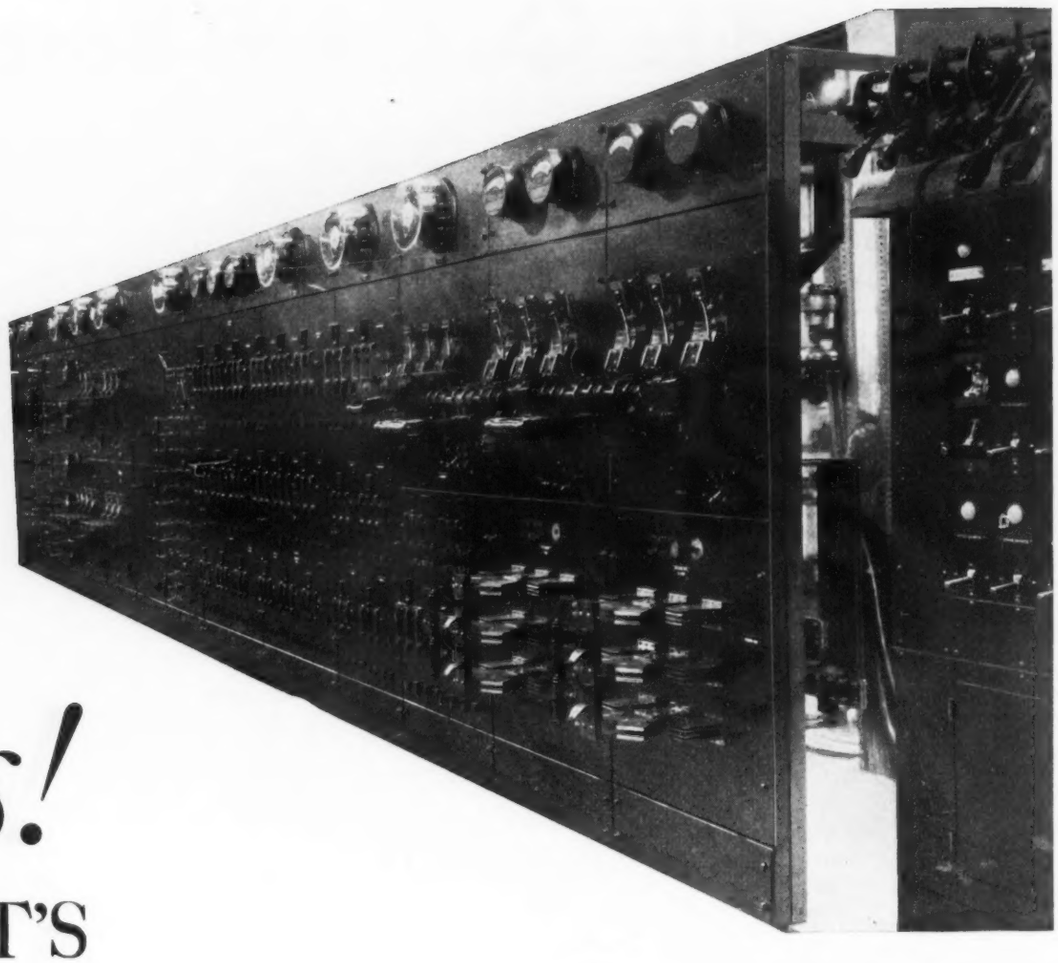
FURTHERMORE, a change in your layout will not obsolete a G&W box. Interchangeable parts enable a G&W box to give yeoman service even though the period of usefulness for its original construction has expired. A G&W cablehead can be replaced with many others of different sizes, shapes, or styles. Entrances are completely interchangeable. Even interior structures can be changed from bolted contacts to links or fuses.

You, too, can effect worthwhile economies for your company by standardizing on G&W—now.

Potheads • Subway Boxes • Cable Terminal Devices • Automatic Transfer Switches

G&W Electric Specialty Co.

7780 Dante Avenue, Chicago • • • • Representatives in Principal Cities



Yes!

THAT'S AMBLER EBONIZED ASBESTOS

The Cole Electric Products Co., Long Island City, N. Y., built this switchboard and the distribution panels for the big new Western Union Building in Boston. Stone & Webster were the general contractors. And again Ambler Ebonized Asbestos was selected!

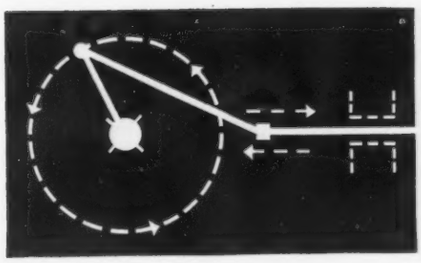
Ambler Ebonized Asbestos is uniform in structure; it is easy to work; surface resistivity is permanent; it has superior physical and dielectric strength; it is approved by the Underwriters' Laboratories; it meets the specifications of the U. S. N. Bureau of Engineering; it is used by leading manufacturers, in large quantities, everywhere.

The universal acceptance and wide use of Ambler Ebonized Asbestos are not without good reason.

AMBLER ASBESTOS SHINGLE & SHEATHING CO.
AMBLER, PA. ST. LOUIS, MO.

AMBLER ASBESTOS PRODUCTS:

Ambler Asbestos Shingles	Ambler Asbestos Corrugated Sheets	Ambler Asbestos Cold Moulded Products
Ambler Asbestos Lumber	Ambler "Ebonized" Asbestos	Ambler Asbestos Waltile



The crank—a simple answer to the complicated problem of converting rotary to reciprocating motion . . . . .

Simplicity of Operation

Lincoln MAXIMUM DEMAND meter

LIKE the crank, the Lincoln Demand Meter is simple in operation. Its maintenance cost is low.

-•-

No part of a Lincoln Meter revolves. Two parts, fundamentally, move through an angle.

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Operates upon the thermal principle. The true heating effect of the load is recognized.

-•-

Over a period of twelve years, it has established successful demand measurement in Canada.

-•-

Equally successful during the past thirty months on hundreds of installations in the United States.

-•-

If you haven't obtained one, write for Bulletin No. 1A.

-•-

-•-

Various instruments available . . . ampere demand, watt demand, indicating, graphic; split core transformers, and totalizers.

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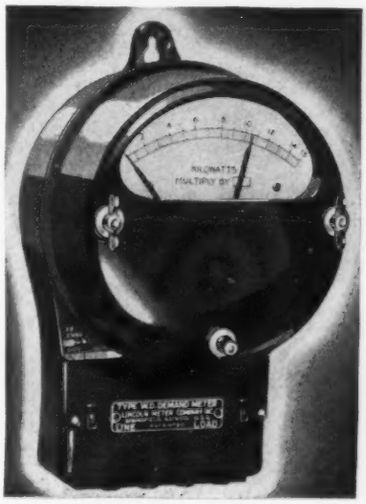
LINCOLN METER CO., Inc.
SPRINGFIELD, ILLINOIS
Associated Factory: Lincoln Meter Co., Limited
Toronto, Canada



Type WD
(watt demand)

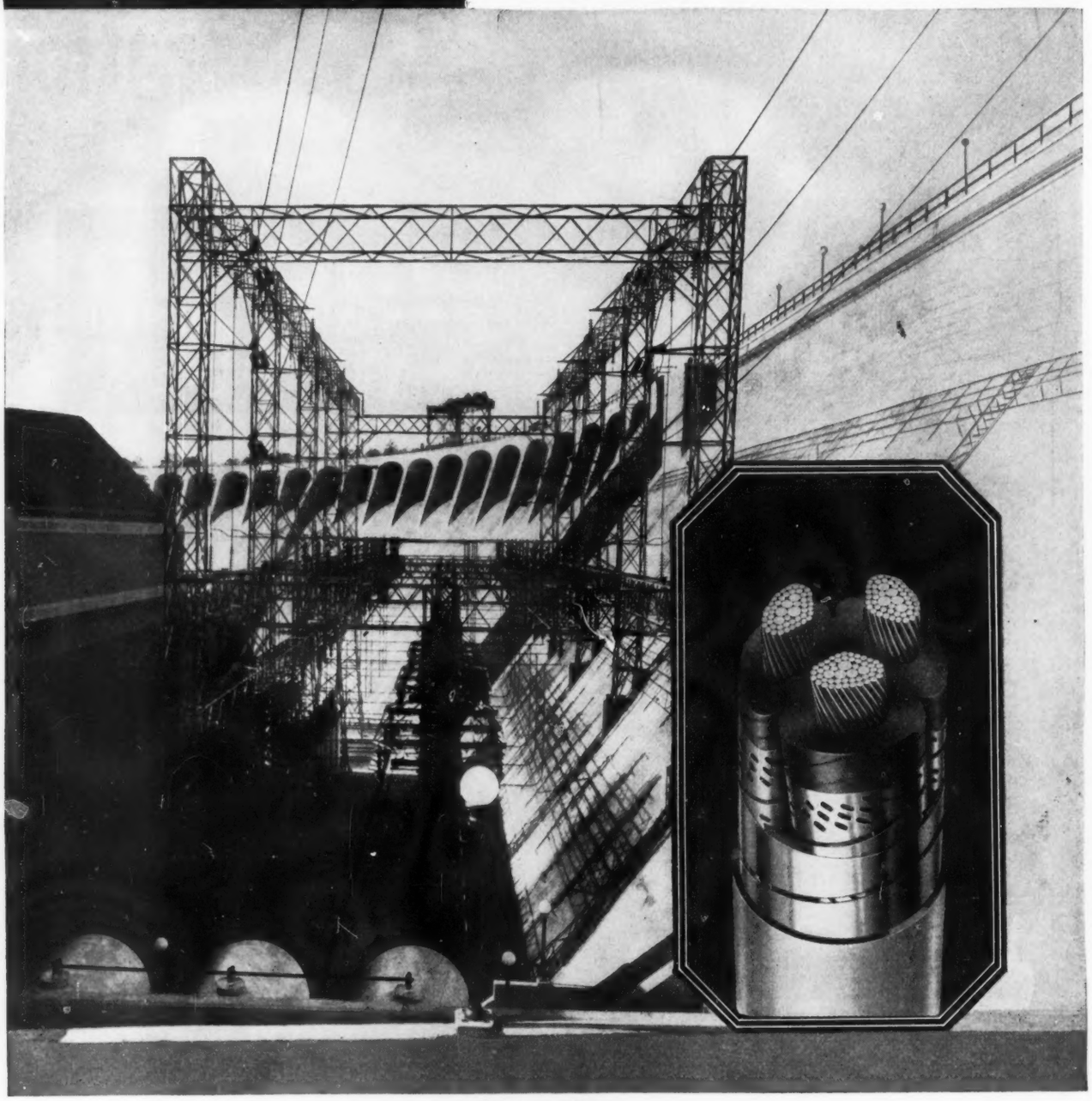
LINCOLN—SIMPLIFIED MEASUREMENT OF MAXIMUM DEMAND

AMERICAN STEEL & WIRE COMPANY

POWER CABLES

For Greatest "Over-all" Efficiency

In the case of power companies, the dependable transmission of current is entrusted to power cables produced by the American Steel & Wire Company. This is in keeping with the almost universal trend of industry to choose wire and cables of proved performance—and from a reliable source of supply. Today—write for complete details of our ability to serve you—both from a product and engineering standpoint.



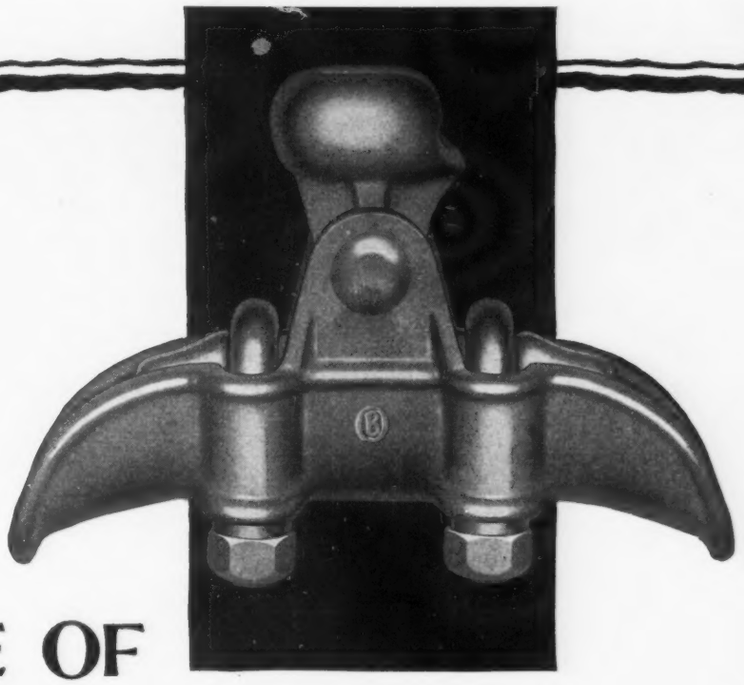
1831 — COMMEMORATING AMERICAN STEEL & WIRE COMPANY 100 YEARS of PROGRESS IN WIRE MAKING — 1931

AMERICAN STEEL & WIRE COMPANY

208 South La Salle Street, Chicago — SUBSIDIARY OF UNITED STATES STEEL CORPORATION — And All Principal Cities

Pacific Coast Distributors: Columbia Steel Company, Russ Building, San Francisco

Export Distributors: United States Steel Products Company, New York



A NEW LINE OF *Light-Weight* O-B SUSPENSION CLAMPS

GREATER economy in construction costs of transmission lines, and standardization of materials were among the most important subjects discussed at the recent N.E.L.A. Convention. Obviously, the adoption of such principles and practices will result in worth-while economies, for "custom-made" materials cannot be manufactured or obtained within the price limits made possible by standardized lines.

Coincident to this new viewpoint in the industry, there is announced a new, complete line of *light-weight* O-B suspension clamps, for all sizes of conductor from 2-0 to 795,000 C.M. While suited to A.C.S.R. conductor with armor rods, this line will serve equally well with other types of conductors of comparable size requirements. These new clamps while conforming in general design to the type of clamp first introduced by O-B, are distinctly different, and embody design features made necessary by the character of the service they must perform.

A shorter, smooth conductor seat, of proper curvature to best serve the cable; much lighter weight; "J" bolts or "U" bolts depending upon the grip required; and general compactness are characteristics of these clamps.

These new clamps are of O-B Flecto iron, hot-dip galvanized. By the use of the Flecto process, thinner sections of metal have been employed without danger of internal weakness or embrittlement. Adequate strength is provided, and the corrosion-resisting characteristics of O-B Flecto iron assure a service life for these new clamps which will equal or exceed the life of the other materials employed in transmission line construction.

Complete information on this new standard line of O-B *light-weight* suspension clamps is in the hands of all O-B representatives, or can be obtained by addressing—

SEND FOR COMPLETE INFORMATION

1437-H

OHIO BRASS COMPANY

Mansfield, Ohio, U. S. A.

Canadian Ohio Brass Co. Limited — Niagara Falls, Ontario, Canada

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ROEBLING

IN MAKING Roebling Lead Sheathed Power Cable—and other Roebling Wires and Cables—every possible precaution is taken to insure a product of unvarying high quality.

Roebling first of all works to most exacting standards. Secondly, it makes certain that these standards are met by rigidly controlling every step of the production process. From copper drawing to shipping the finished product, all operations are performed by Roebling.

Your request for further information regarding any of the many types of wires and cables listed would be welcomed by the nearest Roebling office.

Power Cables · Paper; Cambric; Rubber » Submarine Cables » Tree Wire » Parkway Cable » Service Cables » Station Cables » Rubber Covered Control Cables » Rubber Covered Wires and Cables · Braided and Leaded · Code: Intermediate; 30% » Slow-burning Wires and Cables » Weatherproof Wires and Cables » Portable Cords » And a wide variety of other wires and cables.

JOHN A. ROEBLING'S SONS COMPANY, TRENTON, N. J.
Atlanta Boston Chicago Cleveland Los Angeles New York
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ELECTRICAL WIRES AND CABLES

CORNERS at a 35% SAVING

Made With Either Eye or Clevis

THESE clamps have a slack-pulling clevis attachment which permits slack to be pulled in the span in a direct line of pull. The wedge and block of the clamps are made of drop forged steel; the shell is made of heat-treated aluminum which effectively breaks the magnetic circuit. Quickly installed but easily loosened should slack pulling become necessary.

James R. Kearney Corporation
4224-42 Clayton Avenue
Saint Louis, Missouri
Factories:
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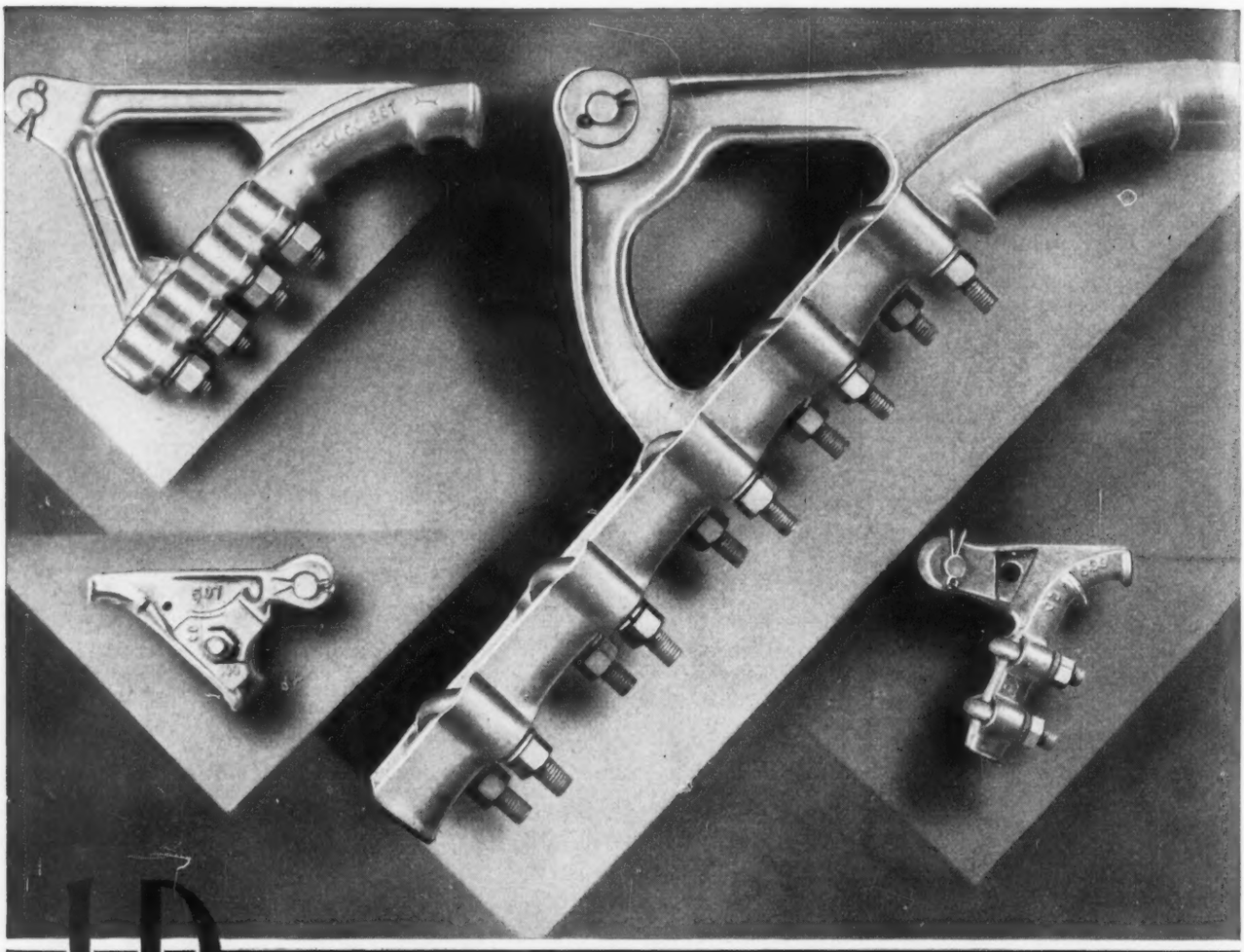
OTHER KEARNEY PRODUCTS

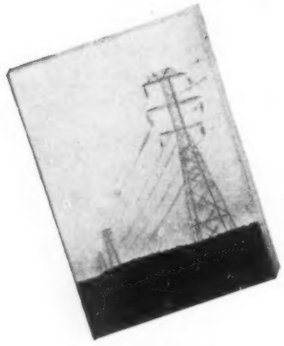
Kearney Hi-Tension 4-in-1 Expansion Anchors, all made of certified malleable iron, guaranteed against breakage; Solderless Wire Connectors; Guy Wire Clips; Double Duty Fuse and Disconnect Cutouts; Single and Two-Insulator Fuse Switches.

KEARNEY

ECONOMY CABLE CLAMPS



J-D strain clamps for every purpose



Write for this clamp booklet today

Here are strain clamps for aluminum and copper showing both extremes in sizes.

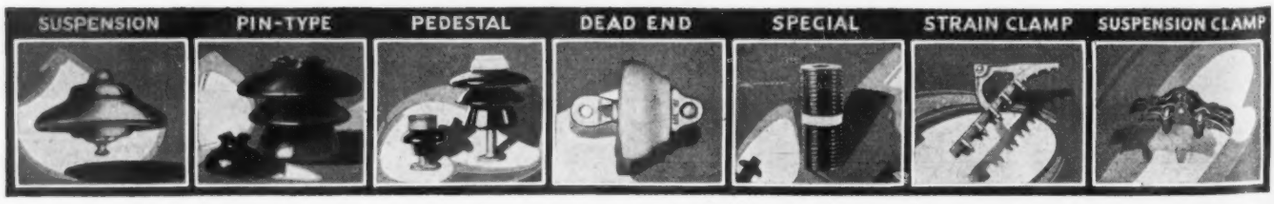
Recent changes in power transmission practice have changed the size range demanded in clamps. This is true especially of suspension clamps for gripping aluminum cables with vibration dampener rods.

J-D clamps cover the modern size range properly.

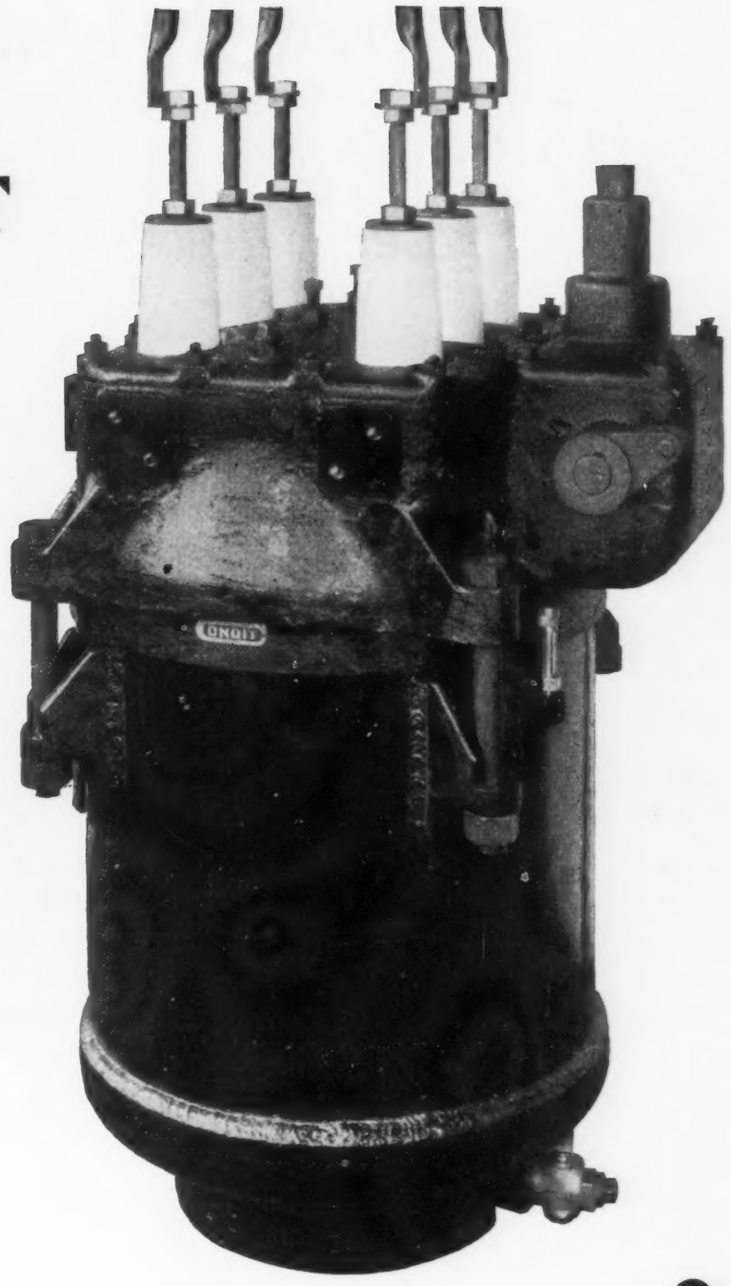
By ordering for shipment with the insulators and connecting fittings, the purchaser is sure that his clamps will not be the cause of any delays to construction work.

The Jeffery-Dewitt Insulator Company

Kenova West Va.



MAY WE INTERRUPT YOU



to call your attention to one of our newest DR interrupters—the Condit DR-60—and also to the following features of its construction: all poles in one tank, totally enclosed mechanism, gasketed joint between tank and frame, oil and gas separator and *Condit reactive loop contacts.* These ensure "quick clearing" operation, freedom from oil throwing and smaller space requirements. The other DR types are similar except that in the lower interrupting capacities rectangular tanks are used. The use of rectangular tanks in the smaller sizes provides greater clearances than is possible with cylindrical tanks and thereby permit higher ampere capacities. Write for the full story.

DR-60

"Get in touch with Condit"

CONDIT ELECTRICAL MANUFACTURING CORPORATION

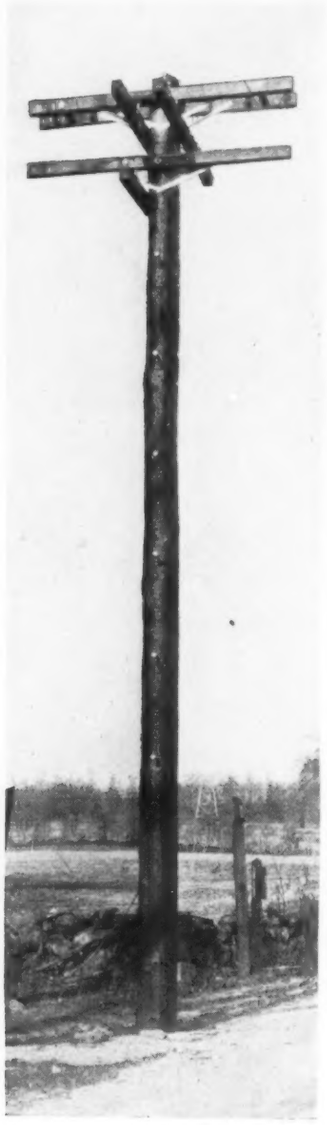
Boston, Massachusetts, U. S. A.

CONDIT

MONTAN-CREOSOTE

Marking a New Economic Advance

In the Preservation of Poles and Cross-Arms



The Pole That Cost $150,000.00

This pole, the first to be treated full length by the Montan-Creosote Process and put into actual service,—cost MONTAN, Inc., six years of research and a development expense of $150,000.00. Thus the first successful non-bleeding Creosote-treated Pole was brought into being.

MONTAN-CREOSOTE

Pressure-treated Poles and Cross-Arms offer the following outstanding advantages:—

1. All the preservative value of Creosote, acknowledged the best wood preservative.
2. Permanence of treatment through combination of Montan Wax and Creosote.
3. Poles that are dry and clean, and cannot bleed.
4. Improved public-relations in the most thickly settled communities.
5. Welcome acceptance by linemen because of the cleanness.
6. The overcoming of losses by evaporation.

IN NEW ENGLAND

More than 10,000 Montan Creosote Treated Poles are in service in the lines of a satisfied list of representative Light and Power Companies. —all supplied by our licensee.

MONTAN TREATING COMPANY
141 Milk St., Boston, Mass.

AND NOW

We announce the licensing of

THE WOOD PRESERVING CORPORATION
Koppers Building, Pittsburgh, Pa.

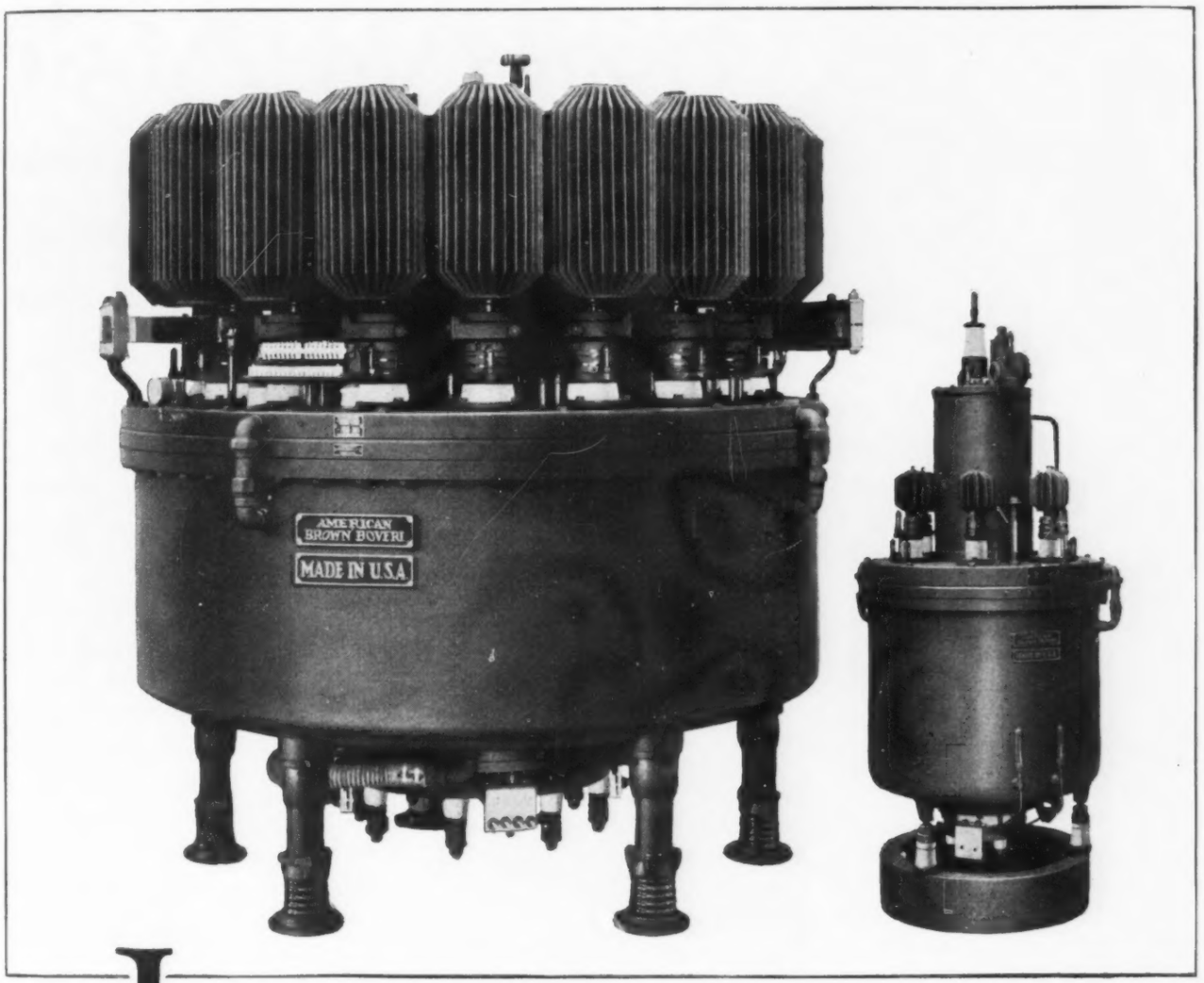
under the MONTAN Patents, and the equipment of its plants at Charleston, S.C. (Carolina Wood Preserving Co.) and at Grenada, Miss. (Ayer & Lord Tie Co.) for the MONTAN-Creosote Treatment.

Please address all inquiries to our licensees.

MONTAN

Incorporated

141 Milk Street, Boston, Mass.



Largest — — — Smallest

For operating the smallest crane or for the largest electric railroad substation or for any application in between, there is an A. B. B. Mercury Arc Power Rectifier.

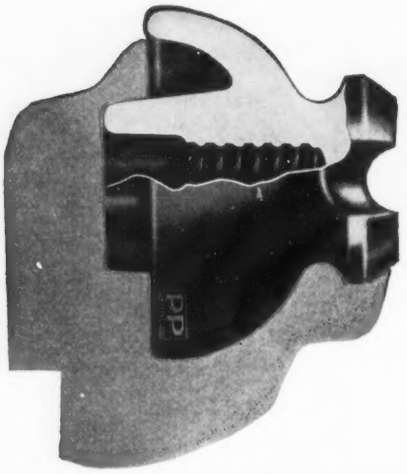
They are now manufactured in sizes from 500 amperes to 12,000 amperes —and the end is not yet.

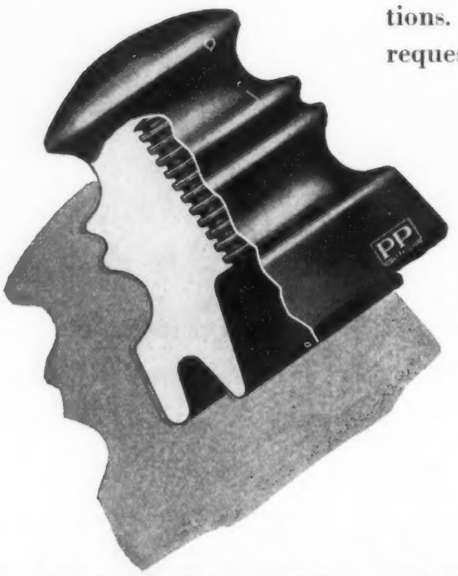
AMERICAN BROWN BOVERI

AMERICAN BROWN BOVERI CO. INC., CAMDEN, N. J.—PIONEERS IN MERCURY ARC POWER RECTIFIERS

From Any Angle

These High Tension Wet Process Porcelain Pin Type Insulators Are Hard To Beat





In Design, Quality, Durability and Efficiency, these High Tension Wet Process Porcelain Insulators meet all the essential requirements of Central Station specifications.

They are made from the highest quality Imported English Ball and China Clays, produced by the best known method, the High Tension Wet Process, by Craftsmen long schooled in the art. Each Insulator is subjected to a puncture test, far in excess of the required voltage, before being packed.

From top to bottom the Catalog numbers of the five Insulators shown here are, 6180, 6188, 6195, 6198 and 6060. Write for detailed specifications and quotations. Samples gladly sent on request.

SALES OFFICES AND WAREHOUSES IN PRINCIPAL CITIES

PORCELAIN PRODUCTS. INC.

PARKERSBURG, W. VA.

LARGEST PRODUCERS IN THE WORLD OF ELECTRICAL PORCELAIN

PP TRADE INC MARK

THYRITE ARRESTERS ARE DESIGNED LIBERALLY

--with ample safety factors to meet these service requirements

Single-pole 69-kv. Thyrite arrester. Described fully in Bulletin GEA-1304.

1. A station-type lightning arrester must prevent apparatus insulation from being stressed near its ultimate strength.

The lightning voltage that can pass beyond Thyrite arresters is lower by a wide margin than the break-down voltage of modern apparatus or standard spillway gaps.

This margin provides security against lightning failures, flashovers, and service interruptions at stations.

2. A station-type arrester must be secure against damage from extremely severe surges.

The flow of current through Thyrite does not involve sparking or arcing, and Thyrite will not puncture or shatter when repeatedly subjected to severe discharge currents.

The energy-dissipating material—Thyrite—has a cross section of 28.2 sq. in., a volume of 21 cu. in. per kv. of arrester rating, and a flash-over distance of 3/4 in. per kv. of rating. This liberal design gives Thyrite arresters the essential margin of safety for the most severe surges, direct strokes near the station, and arcing-ground discharges.

3. A station-type arrester must be secure against failure from excess system voltages. This requires that the maximum re-seal voltage of the arrester be safely above the probable overvoltages of the system.

In addition to the usual line-voltage rating, Thyrite arresters have a maximum permissible line-to-ground voltage rating which is so chosen as to give the arrester a margin of safety compatible with excess system voltages occurring on modern systems.

440-29

GENERAL ELECTRIC

JOIN US IN THE GENERAL ELECTRIC PROGRAM, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

With this 1/5/25-amp. watthour-meter standard you can test service meters up to 50-amp. capacity

Type IB-9
1/5/25 amperes
100-120/200-240 volts

HERE is a superior standard for precision work—with remarkable accuracy up to 200% load; with almost entire freedom from temperature errors; practically unaffected by variations in voltage, frequency, and power-factor; with low potential losses and therefore no appreciable self-heat error; with high torque an outstanding characteristic.

Among the desirable mechanical features of this new standard are: micrometer adjustment for full load (both wide-range and vernier), light load, and power-factor—all made from the front of the element.

JOIN US IN THE GENERAL ELECTRIC PROGRAM, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

For further information see Catalog GEA-615A

600-35

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

The hooks will hold

They are Drop Forged

Hanging a thousand feet in the air with nothing but a board, some rope and a few forgings between life and death. But we will vouch for their safety in the hooks for they are drop forged and forgings are uniform. There are no flaws to endanger their lives.

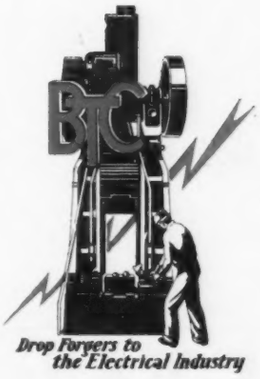
Strength is important but of what value is it without absolute uniformity—reliability? Therein lies the value of the forging. They are uniform. It means an added margin of safety to your lines; an extra protection available by merely specifying BTC drop forged hardware.

Hi-line hardware is an important division at The Brewer-Titchener Corporation. New buildings, special equipment and an entire staff is devoted exclusively to its production. Be assured that hardware with the BTC stamp on it is produced under supervision that understands your problems.

THE BREWER-TITCHENER CORPORATION
Cortland, New York

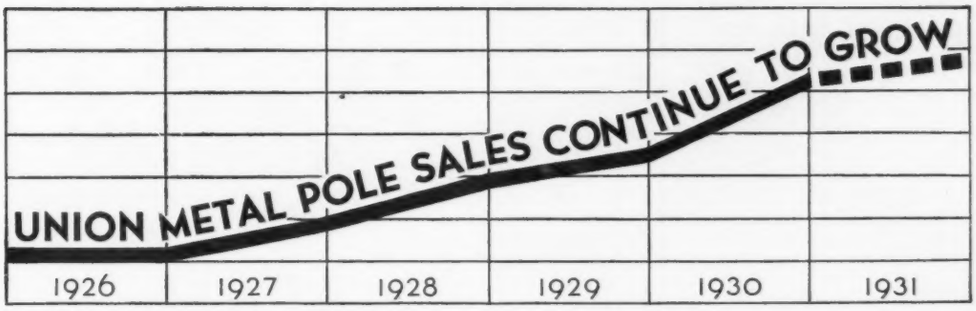
Why a Drop Forged Cap?

1. They are uniform in quality.
2. They are superior in strength.
3. They are uniform in dimensions.
4. They can be heat treated to give maximum strength with minimum weight.
5. They have precision milled joints and drilled holes.
6. They are free from hidden defects and concealed flaws.
7. They give extra protection to your lines.



ASK YOUR INSULATOR MANUFACTURER

UNION METAL FLUTED STEEL



AN INCREASE in sales every year, with 1931 headed in the same direction! That is the story of the acceptance of Union Metal Poles by utility officials and the general public.

Today you will find Union Metal Fluted Steel Poles installed in Los Angeles, Cleveland, New Orleans, Chicago, Vancouver, Detroit, Kansas City, Pittsburgh and dozens of smaller municipalities. Each installation is tailored to order, and constructed to give trouble-free service for many long years.

Because they are fabricated from heavy steel and then cold-rolled, these poles withstand heavy side strains. And because of their strength—and appearance—one set of poles may be used to support trolley span wires, street lighting units, traffic signals, and distribution and transmission lines. The result is true economy for the users of the poles and a decided improvement in street appearance.

THE UNION METAL MANUFACTURING CO.
GENERAL OFFICES AND FACTORY • CANTON, OHIO

SALES OFFICES • New York • Chicago • Boston
Los Angeles • San Francisco • Dallas • Atlanta

DISTRIBUTORS: General Electric Merchandise Distributors • Graybar Electric Company, Incorporated
Offices in all principal cities

ABROAD: International General Electric Co., Inc.
Canadian General Electric Co.

At left, Union Metal Poles installed recently on Eighth St., Los Angeles.

DISTRIBUTION POLES

Single conductor 25 K.V. Anaconda Oil Tight Pothead

81

Potheads are only one of the 81 quality products that bear the Anaconda name and trademark.

ANACONDA
from mine to consumer

Potheads that are TIGHT!

—OIL tight
—AIR tight
—VACUUM tight

Designed by experienced cable engineers and manufactured with our usual accuracy, Anaconda Potheads offer several decided improvements . . . among them extreme simplicity, interchangeability of parts, Dardelet self-locking threads, *vacuum tight* construction. They assure continuity of service!

Throughout the entire line of Anaconda Cables and Cable Accessories, Anaconda's broad, practical experience works to your advantage.

ANACONDA WIRE & CABLE COMPANY

GENERAL OFFICES: 25 BROADWAY, NEW YORK
CHICAGO OFFICE: 20 NORTH WACKER DRIVE
Sales Offices in Principal Cities

P&H Fast Shipping Service sets New Records

IN the Page & Hill organization, the word "Service" is taken seriously as a guiding principle throughout every activity in the manufacture and shipment of cedar poles.

"P & H" Rapid Shipping Service includes prompt loading for shipment; intensive and ceaseless car tracing; speedy, complete, and accurate information to customers on car movements. During the past twelve months, 84 per cent of all our orders were loaded within 48 hours after receipt—69 per cent were loaded within 24 hours.

This Service enables you to reduce the number of poles stored in your yards, thus lowering handling costs, storage charges, insurance and interest on inventory.

Fast Shipping Service is just one of the reasons why "P & H PROCESS" Poles are

"Still in the Lead"

PAGE AND HILL CO.

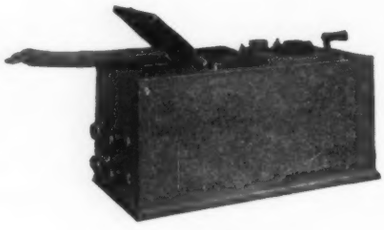
MINNEAPOLIS, MINN.

New York, N. Y. 50 Church St. Chicago, Ill., 20 North Wacker Drive Bldg. Boston, Mass., 733 Public Service Bldg.
Pittsburgh, Pa., 1210 Grant Bldg. Dayton, Ohio, 854 Reibold Bldg. Kansas City, Mo., 801 Dwight Bldg. Omaha, Neb., 711 Elec. Bldg.

Making a substation ground resistance test—using the "Megger" Ground Tester.

"We feel that ground testing is absolutely necessary to give us the maximum protection from our lightning arresters, and that the (Megger) ground tester enables us to keep these grounds at a point of most service to us."

From a Lighting Company in New York State



"MEGGER"
GROUND TESTER

For many companies this season marks the fourth consecutive year during which they have made systematic tests of ground connection resistances with our direct-reading "Megger" Ground Tester. "Megger" ground testing has found its place in the electrical industry side by side with "Megger" insulation testing

THROUGHOUT the United States, power companies, railroads, telephone and telegraph companies, large industrials, and federal and municipal departments have adopted the "Megger" Ground Tester for their ground resistance tests. We have sold *hundreds* of these instruments. More than thirty-five companies have placed *multiple or repeat orders.*

Engineers responsible for such tests will find it highly desirable to use the "Megger" Ground Tester, because it is self-contained, simple to operate, *direct-reading* like a voltmeter, wide in range and free from the effects of stray currents in the earth.

Write for our 64-page Technical Bulletin on Ground Testing—No. 1260-W.

JAMES G. BIDDLE CO.
ELECTRICAL INSTRUMENTS
1211-13 ARCH STREET PHILADELPHIA, PA.

"Megger," "Meg" and "Super-Meg" Insulation Testing Instruments
"Megger" Ground Tester

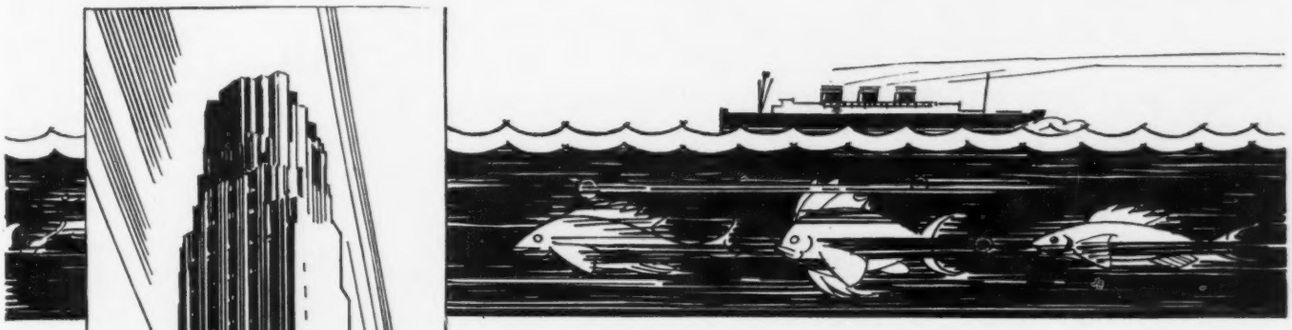
"Megger" and "Meg" Direct-Reading Ohmmeters
Dionic Water Tester

Frahm Vibrating-Reed Frequency Meters and Tachometers

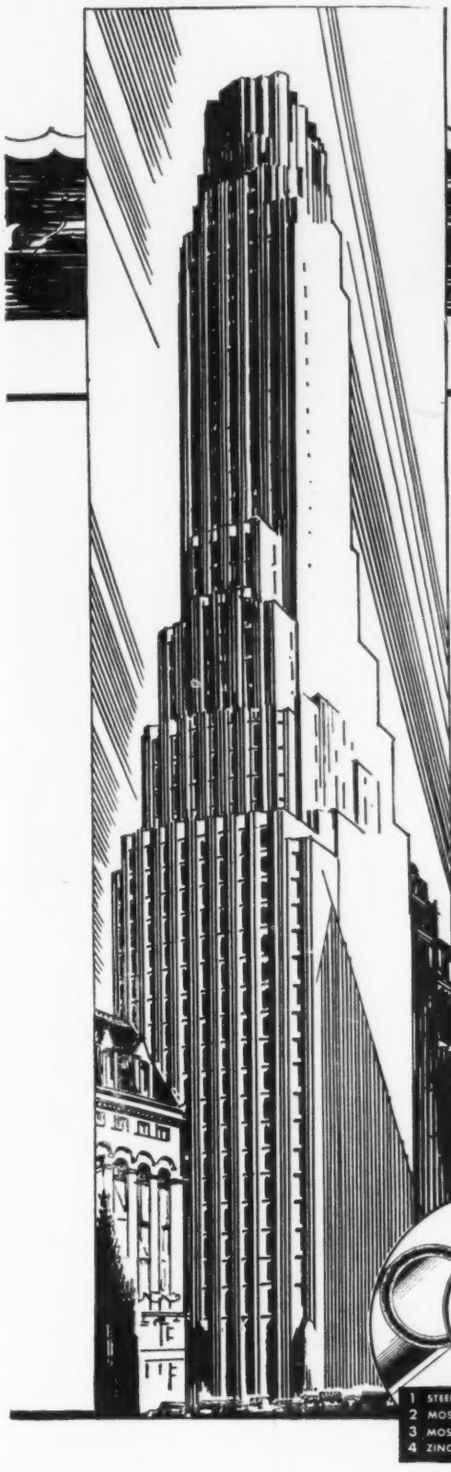
Jagabi Rheostats and Resistance Boxes
Precision Potentiometers
Siemens & Halske Precision Instruments

Jagabi Hand Tachometers, Tachoscopes and Speed Indicators
and Oscillographs

PROTECTING WIRING



BELOW SEA LEVEL AND HIGH IN THE AIR



AT One Wall Street, the electric wiring has a doubly important duty. It must help guard the treasure of a great bank, deep down in vaults below the level of the sea. And it must assure unfaltering electrical service to fifty stories of offices, the homes of national business leaders.

To make certain of the fullest possible protection, G-E Rigid Conduit was chosen for use throughout this building. For more than eighteen years, G-E "White," the original hot dipped galvanized rigid conduit, has repeatedly shown its ability to give lasting protection under all conditions.

Both G-E "White" and G-E "Black" are now made of a new kind of steel . . . a steel that bends easier than any ever before made. Only G-E Rigid Conduit is made of this new steel. So to its known protection is added an easy workability that makes it the "pipe" you have long wanted.

You can always get G-E Rigid Conduit, Boxes, and Fittings quickly from a G-E Merchandise Distributor near you.

One Wall Street, New York

New Home and Office Building of the Irving Trust Company

Architect: — Voorhees, Gmelin & Walker

Electrical Contractor: — J. Livingston & Co.

Consulting Electrical Engineer: — Meyer, Strong & Jones, Inc.

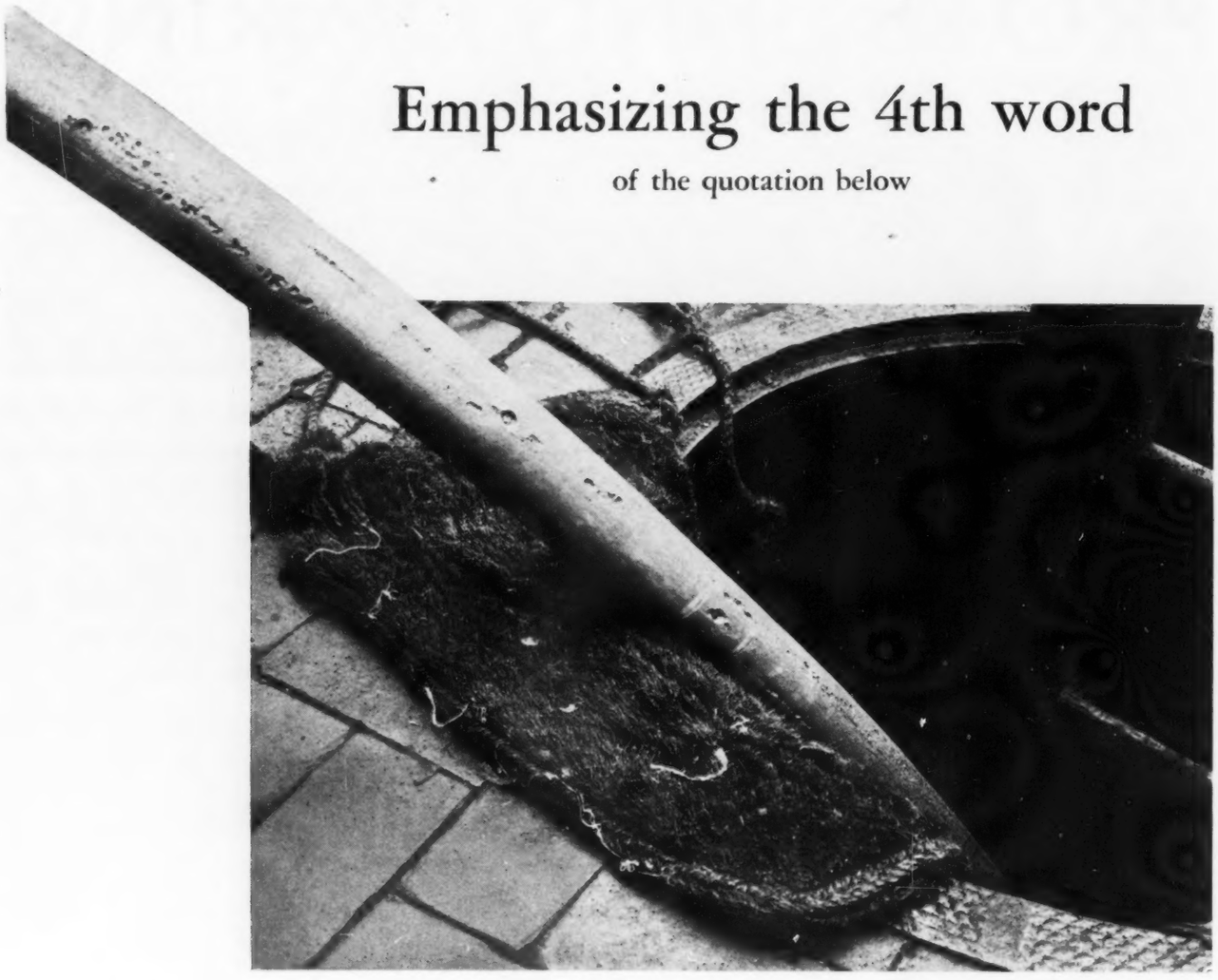
GENERAL ELECTRIC

RIGID CONDUIT

MERCHANDISE DEPARTMENT · GENERAL ELECTRIC COMPANY · BRIDGEPORT, CONNECTICUT

Emphasizing the 4th word

of the quotation below



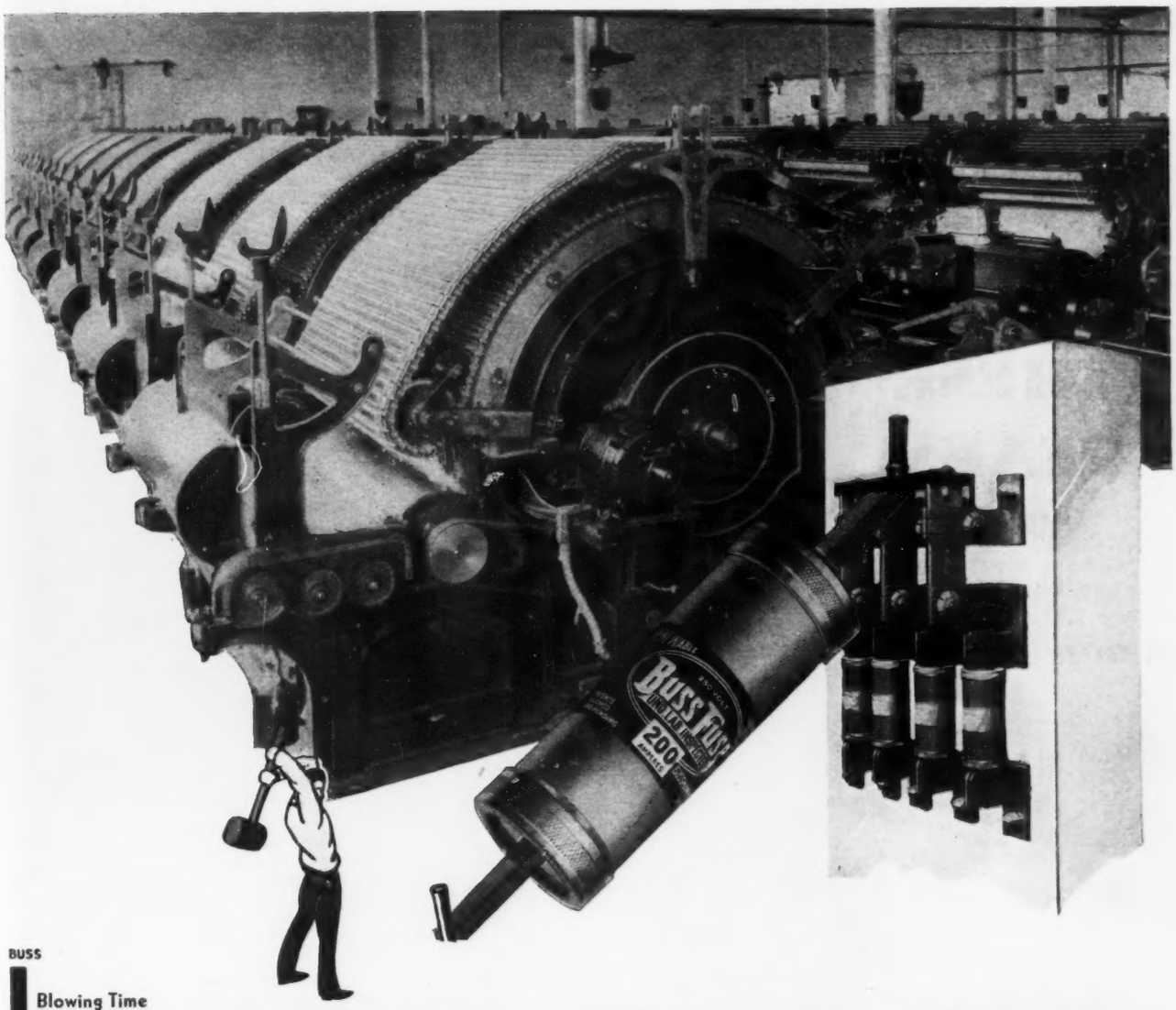
The April and May issues of The Purchasing Agent carried a continued story "Insulated Wires and Cables" by Mr. Francis A. Westbrook, M. E. Under the heading "INSPECTION" Mr. Westbrook writes:

"Public utility companies generally have their paper cables inspected at the factory to make sure that they meet with the requirements of the specifications. The greater part of this inspection is performed by the Electrical Testing Laboratories of New York and a few large companies maintain inspection departments of their own. Advantages of E.T.L. inspection are that it is generally cheaper, the inspectors are specialists in their line, instead of being general inspectors of many products, and above all, an opportunity is afforded to subscribers to the E.T.L. service to see how cables of different makes and how cables supplied to different utilities compare with one another in quality as far as this can be ascertained from factory tests."

Thus they

Know—
by Test

Electrical Testing Laboratories
80th Street and East End Ave.
New York N.Y.



BUSS

Blowing Time of BUSS SUPER-LAG Fuse Compared to Other Makes.

This chart shows results obtained in tests made by Electrical Testing Laboratories of New York as reported by them August 25th, 1930 on the 200 ampere 250 volt size. 30, 60, 100, 400 and 600 ampere sizes as reported by them show similar results.

HOLD THAT LINE!

BLOCK NEEDLESS DELAYS—

Sounds like football, but doesn't it apply to fuses too? Surely you don't want fuses to break down and throw your lines out of service every time there is a little extra surge of current.

Wouldn't you rather have fuses that will hold the lines in operation, keep machines running and the lights on? Fuses that will hold most of these harmless overloads yet will blow promptly *on short circuits or dangerous overloads*?

Just glance at the chart to the left. It gives you an idea of how the new BUSS SUPER-LAG Fuse compares with old type fuses. Now you can fortify your plant against those annoying current surges that have heretofore been so difficult to control.

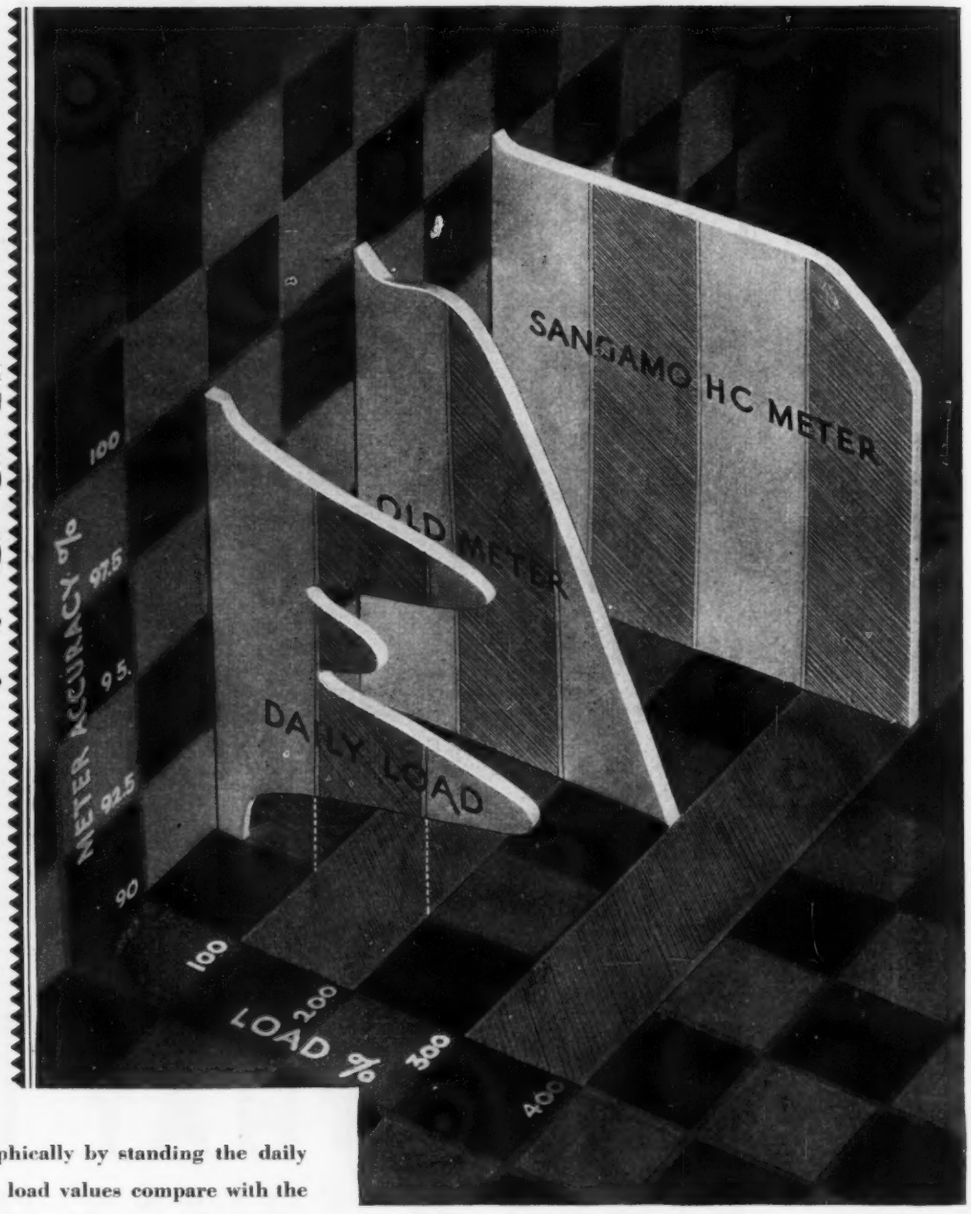
Why not specify BUSS SUPER-LAG Fuses on your next order? Or let us send our nearest representative to consult with you on your fuseing problem.

If you prefer more information before taking definite action, drop us a line and we will send you complete information by mail about the new BUSS SUPER-LAG Renewable Fuse.

BUSSMANN MFG. CO., ST. LOUIS, MO.
A Division of the McGraw Electric Company

BUSS SUPER-LAG FUSE

THESE PEAKS PAID *for a new meter*



How they paid is shown graphically by standing the daily load curve on end so that its load values compare with the load ordinates of meter-accuracy curves. The dark bands carry the eye to corresponding loads and show the accuracy of the meters at those loads.

Building load with appliances imposes an entirely new service on the house meter—loads like the one shown.

From a steady unity power-factor load with a few flat-top peaks, the new load becomes widely fluctuating with many sharp peaks and frequently low power-factor.

Furthermore, the dollar cost of errors, such as those due to changes in surrounding temperature, mounts with the magnitude of the loads measured.

Therefore, from every standpoint, the plan of building more-load-per-customer calls for modern meters . . meters that carry these new loads with accuracy undiminished under all service conditions.

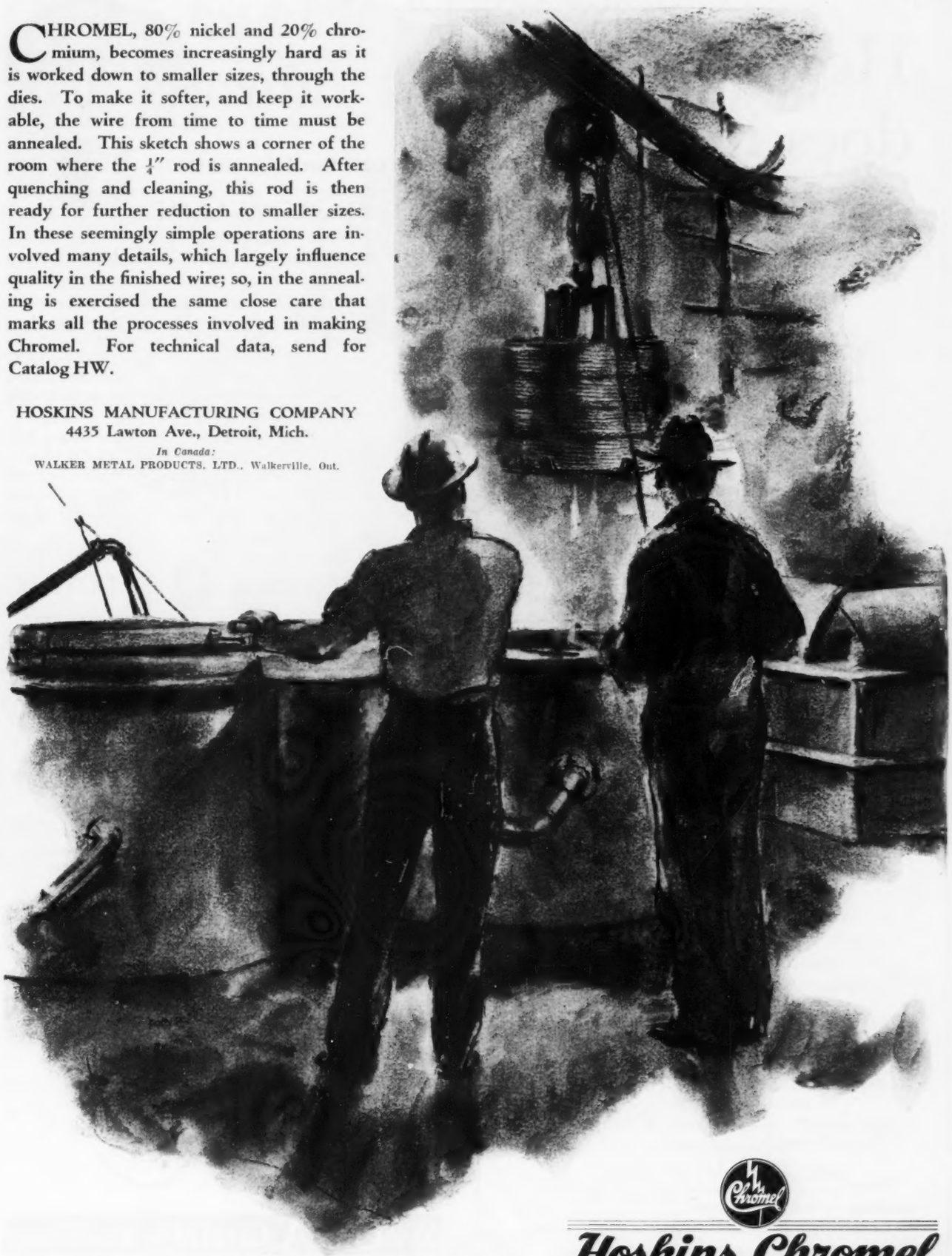
Sangamo HC is the more-load-per-customer meter. It has a straight-line accuracy curve up to 300% load. The HC is not affected by temperature. While loads are building, the HC will measure the peaks and thus, without loss of revenue, bridge the gap to the final load which will require a larger meter.

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

INTIMATE GLIMPSES INTO AN IMPORTANT INDUSTRY—*No. 7 of a Series*

CHROMEL, 80% nickel and 20% chromium, becomes increasingly hard as it is worked down to smaller sizes, through the dies. To make it softer, and keep it workable, the wire from time to time must be annealed. This sketch shows a corner of the room where the $\frac{1}{4}''$ rod is annealed. After quenching and cleaning, this rod is then ready for further reduction to smaller sizes. In these seemingly simple operations are involved many details, which largely influence quality in the finished wire; so, in the annealing is exercised the same close care that marks all the processes involved in making Chromel. For technical data, send for Catalog HW.

HOSKINS MANUFACTURING COMPANY
4435 Lawton Ave., Detroit, Mich.
In Canada:
WALKER METAL PRODUCTS, LTD., Walkerville, Ont.



Hoskins Chromel

THE WIRE THAT MADE ELECTRIC HEAT POSSIBLE

How hot does it get?

(Socket Heating Report Tells)

THE National Electrical Code recognizes the possibility of trouble in sockets by insisting that specially insulated wires be used in any socket where the temperature exceeds 120°F. (49°C.). They further consider that all mogul base lamps attain this temperature in sockets—and they surely do.

But many of the smaller lamps reach surprisingly high temperatures—as anyone knows who's burned his fingers removing lamps from sockets.

Just where is the line to be drawn? We've made tests to determine the maximum temperatures reached in sockets holding lamps of relatively low wattages—25, 50, 75 and 100 watts—and the results indicate that all indoor fixtures should be wired with heat-resisting insulated fixture wire in order to meet requirements of Article 6, Section 604-a, National Electrical Code.

We'll be glad to send a copy of this report to any engineer requesting it. Use the convenient coupon below or address—

ROCKBESTOS PRODUCTS
CORPORATION
362 NICOLL ST. NEW HAVEN, CONN.

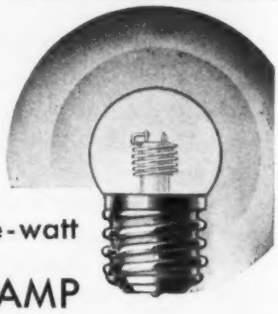
Please send.....copies of your report on "Socket Heating."

Name.....

Company.....

Address.....

ROCKBESTOS—*The wire with permanent insulation*



You can use this one-watt

NEON GLOW LAMP

on both A. C. and D. C. Lines

Wherever low level illumination is desired as a guide or indicator—there the little 1.0 watt Neon Glow Lamp "fills the bill" at almost nothing in current cost. Operates on either A. C. or D. C. lines. Indicates, in fact, as one of its *many* uses, whether line is A. C. or D. C., since on D. C. only negative electrode glows.

Serves scores of purposes in home, factory, laboratory as night, guide, pilot and signal light or as oscillator. Fits standard socket. Clear glow for more than 3,000 hours! For details and prices, write: General Electric Vapor Lamp Company, 805 Adams Street, Hoboken, N. J.

495-A © G. E. V. L. Co., 1931

GENERAL ELECTRIC VAPOR LAMP COMPANY

Another tool to help you cut down maintenance costs—

The G.C.A. Cartridge-Fuse Tongs

1. For removing and replacing cartridge fuses from ½ inch to 1¼ inch in diameter.
2. Operators and electricians can use it safely and quickly.
3. Small enough to fit into the pocket.
4. Light weight, less than 6 oz.
5. Made of an insulating material containing a cloth compound—combines strength and safety. No metal parts.

Write for catalog.

REGISTERED U.S. PAT. OFF. TRADE MARK AND FOREIGN COUNTRIES

The G.C.A. Cartridge Fuse Tongs

The G. C. A. Manufacturing Co.
Pittsfield, Mass.

We named it
G-E Novalux **HANDY** *Floodlight*
and **Why**

FIRST

Because it's handy to stock and easy to sell. The retail price is only *$8.40*

SECOND

Because this new, portable, thoroughly efficient, enclosed projector is so handy for hundreds of every-night uses that the market covers the whole range of city, suburban, and rural prospects—domestic and commercial

THIRD

Because the strong, efficient light from its standard 100-watt inside-frosted lamp is obviously the very thing needed in protecting house, grounds, and garage from mischief-makers; in advertising; in illuminating signs; around service stations, tourists' lodges and camps, parking areas, real-estate developments, and small stores; in lighting driveways and places where evening jobs demand just this inexpensive, *handy* beam

FOURTH

Because it is handy to light the porches and guard the grounds of city houses, to furnish illumination for holiday decoration, and for scores of emergency applications

The Handy may be obtained from:

The General Electric Supply Corporation

Other G-E Merchandise Distributors

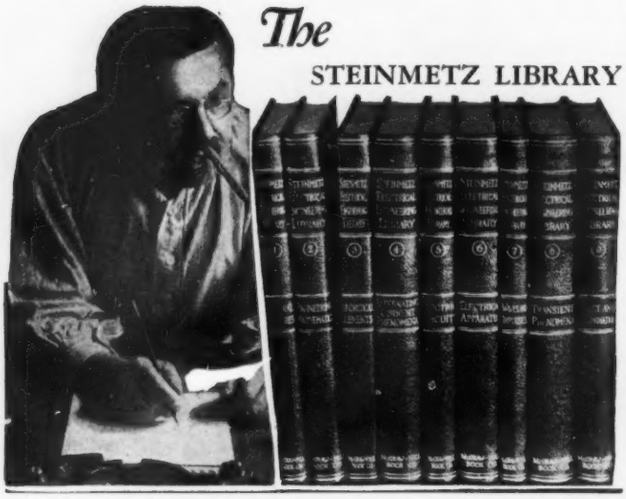
Any G-E Sales Office

Further information is available from any of these sources

710-125

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES



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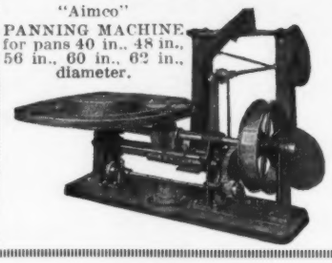

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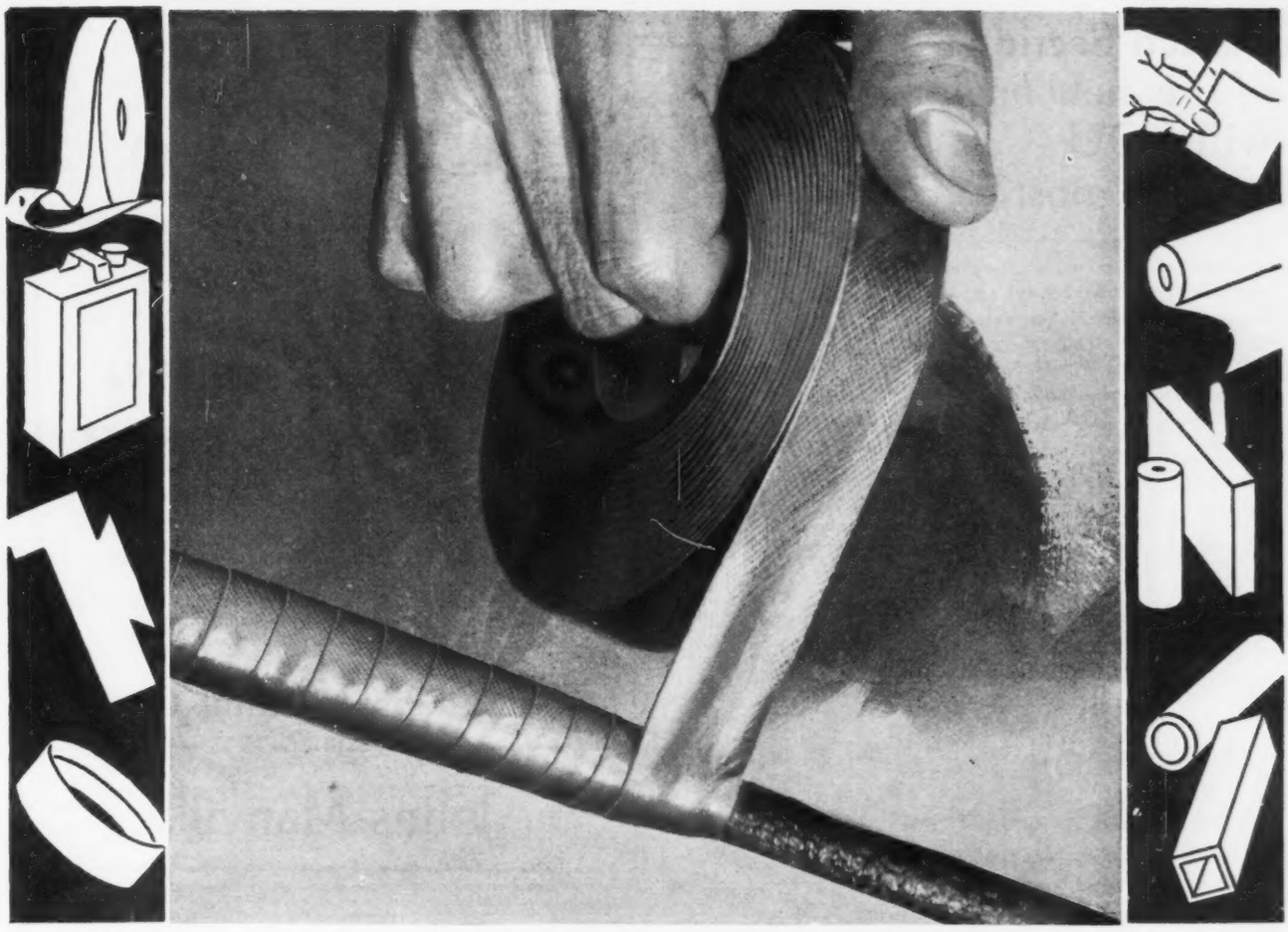

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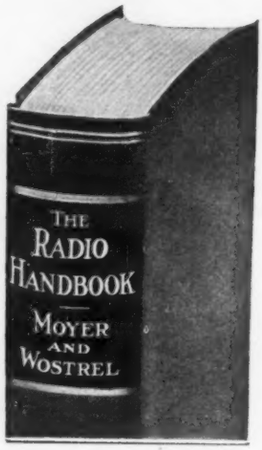

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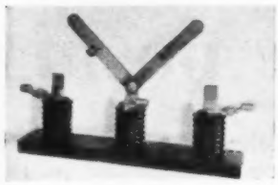

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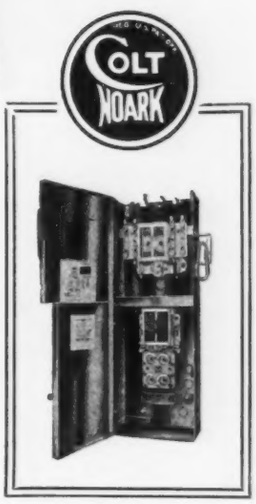

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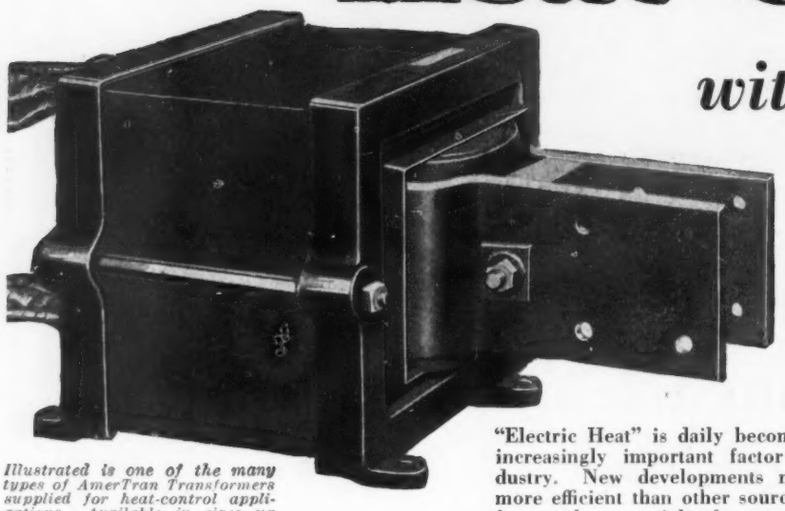

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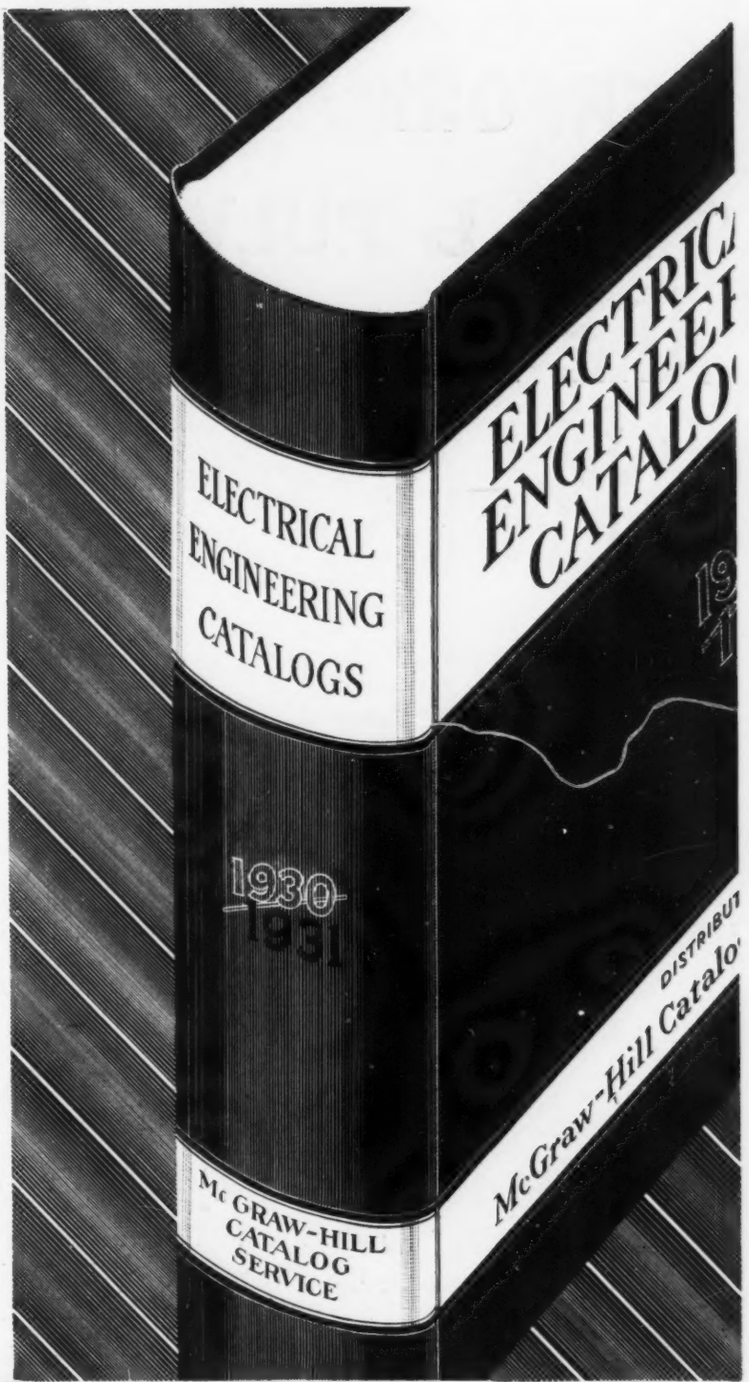

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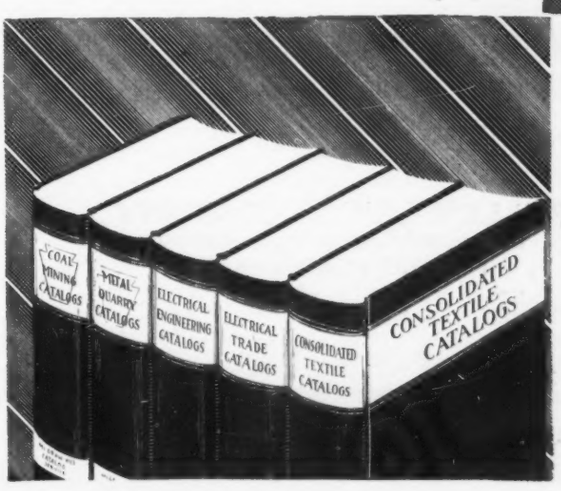

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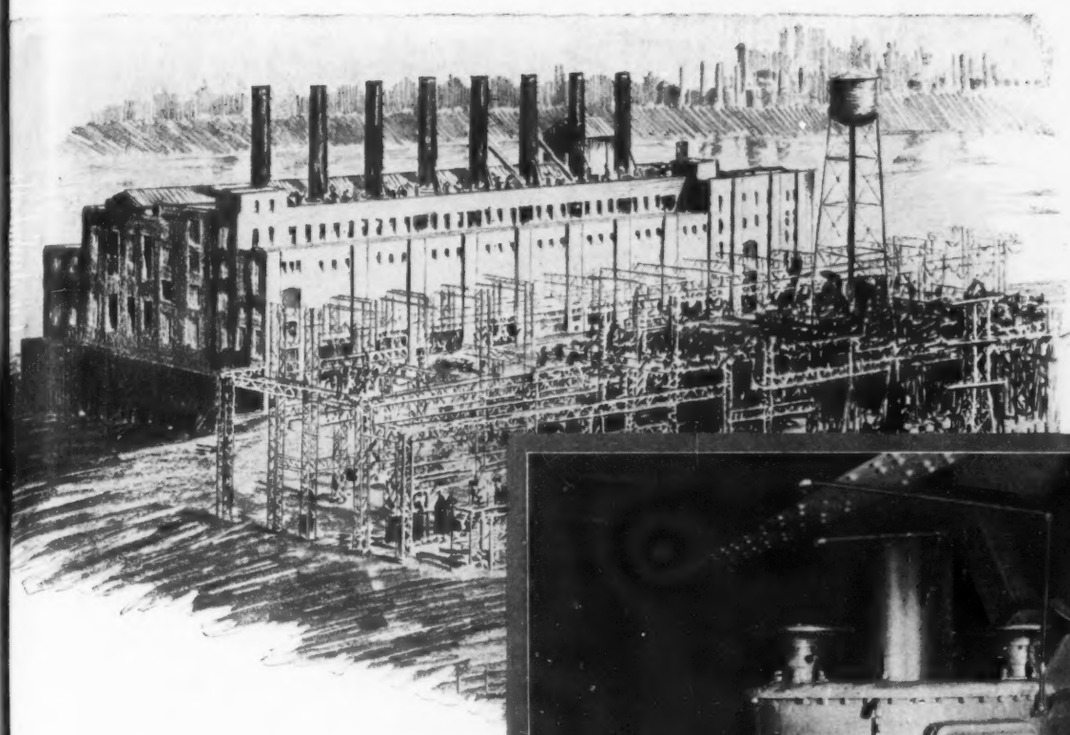

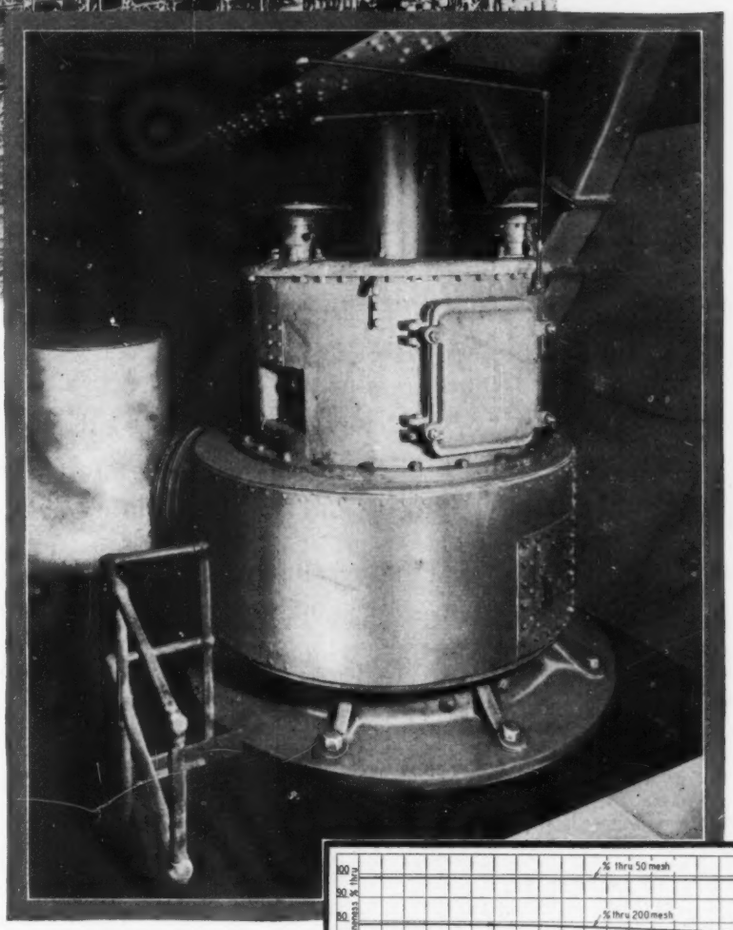

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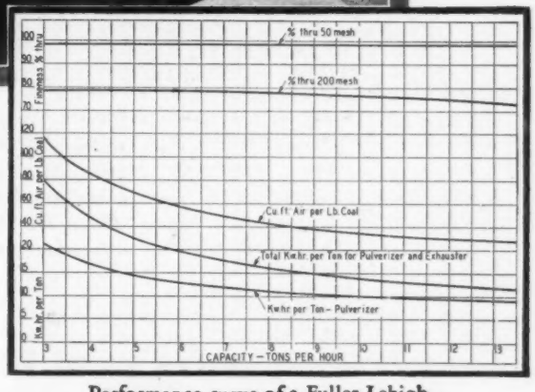
One of the 4 Fuller Lehigh Type B Pulverizers at the Toronto Station of the Ohio Edison Company, Toronto, Ohio.


% thru 50 mesh
% thru 200 mesh
Fineness %
Cu. Ft. Air per Lb. Coal
Cu. ft. Air per Lb Coal
Total Kw.hr. per Ton for Pulverizer and Exhauster
Kw.hr. per Ton – Pulverizer
Kw.hr. per Ton
CAPACITY – TONS PER HOUR

Performance curve of a Fuller Lehigh Type B Pulverizer at Toronto.

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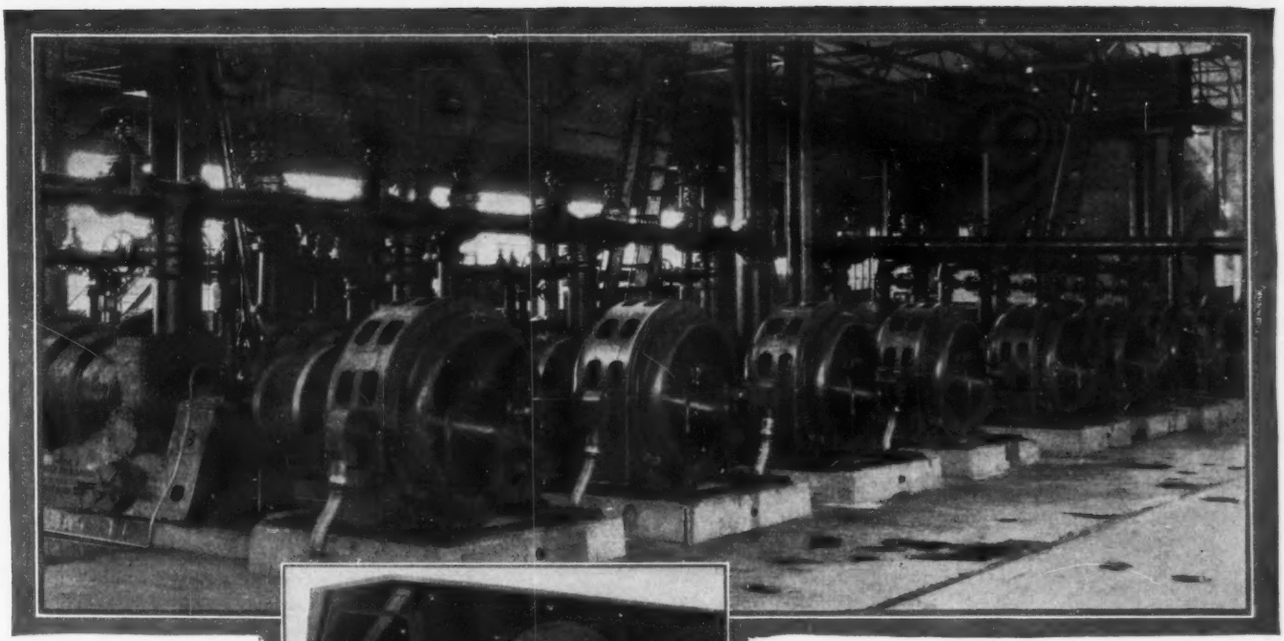

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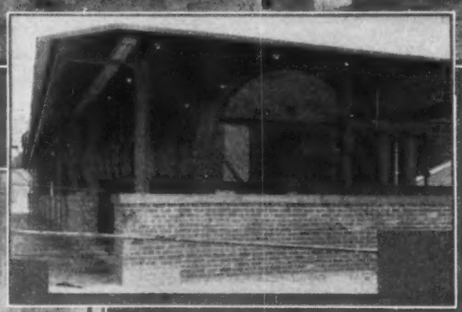

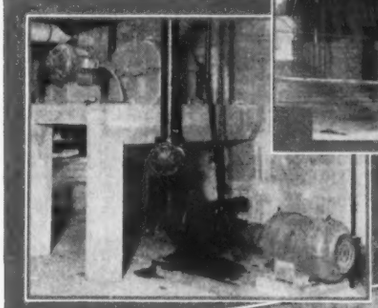

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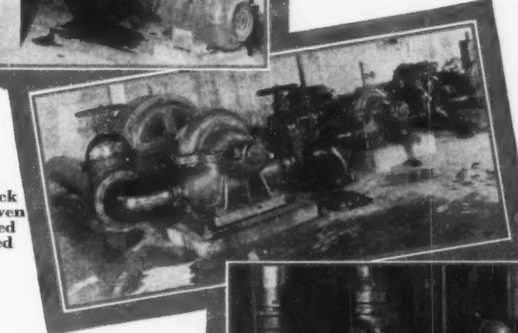
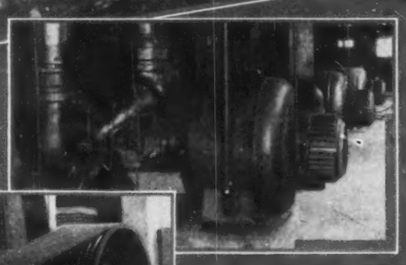


Allis-Chalmers Paper Stock Pump driven by Enclosed Fan-Cooled Motor.



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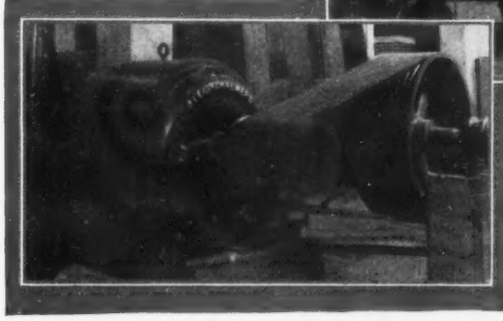

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Two Winding Slip-ring Motor and Texrope Drive, operating winder.

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Allis-Chalmers motors are used throughout the new Panama City Mill and many of the applications are new and unique. A special feature is the large number of totally enclosed fan-cooled motors, extending even to the use of slip-ring and synchronous types.

Every motor in the digester building is of the enclosed type, first because of corrosive gases and secondly, because of the water hazard due to the washing of equipment.

The barking drums are driven by special synchronous motors. The winder drive consists of a two-winding slip-ring motor and simplified control instead of the complicated D.C. system usually employed.

Allis-Chalmers also furnished eighteen improved paper stock pumps, thirty high efficiency double suction pumps, and a fire pump, all but the latter being motor driven. Texrope Drives total well over a thousand horsepower. A 10'x 135' Allis-Chalmers lime kiln is used in the Recovery Building.

Allis-Chalmers has furnished equipment for practically every southern mill, producing kraft and with this experience is in a position to make recommendations and furnish equipment suited to this class of service, not only from a theoretical, but also a practical standpoint. Our nearest district office will be glad to co-operate with you in improving your operating conditions.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee

Steel Strengthened Motors

Strength and rigidity, in addition to mechanical simplicity, are the characteristics of Wagner stator frames and feet. They are fabricated from heavy steel and electrically welded. » » » This is an age of steel. Because of its strength and ease of manufacture, steel has forged to the forefront as the preferred fabricating material. Wagner utilizes steel wherever possible, to give motors additional strength without additional weight. » » » Wagner steel strengthened motors are completely described in Bulletin 165, a revision of which has just come off the press. The bulletin discusses Wagner's seven types of squirrel cage motors, explaining how they differ from one another, how they are made, how to apply them to fit the job, etc. You will find the bulletin a valuable addition to your reference library. The coupon is for your convenience.

Steel Frame — strong and rigid; in one piece, no parts to work loose and cause trouble — can't sag or get out of alignment under the severest operating conditions; maintains uniform air gap.
Heavy Angle Iron Feet—welded to steel stator frame—strong and rigid, no breakage.
For complete construction details, see pages 12 and 13, Bulletin 165—copy of which will be mailed on request.
Wagner
Squirrel-Cage Motors

SIGN AND MAIL THIS COUPON

WAGNER ELECTRIC CORPORATION,
6400 Plymouth Ave., St. Louis, Mo.

Please send copy of the completely revised Bulletin 165 on Squirrel Cage Motors.

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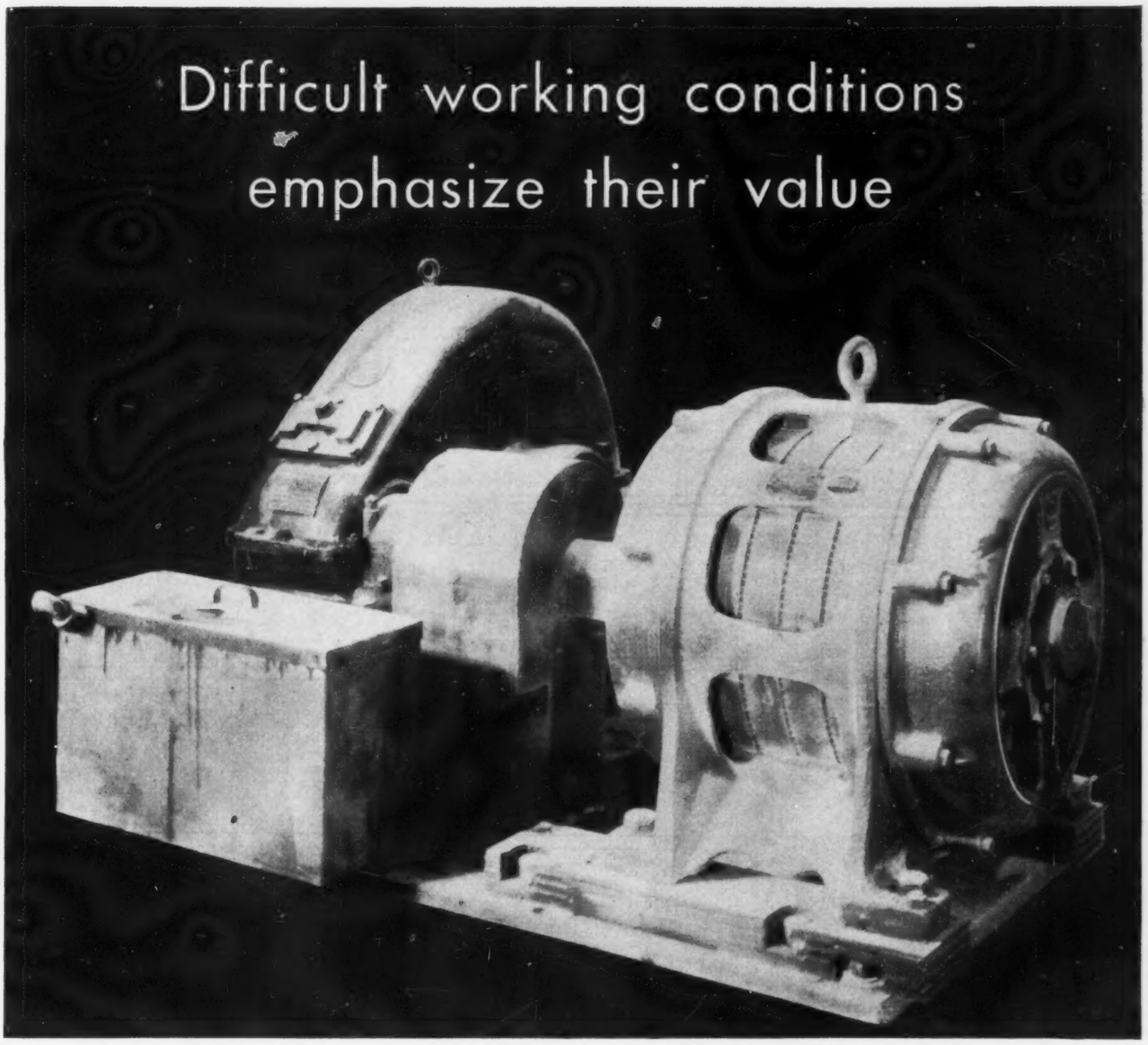
LOCKHEED HYDRAULIC BRAKES

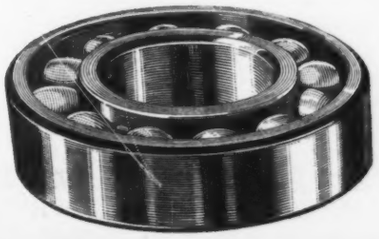
L331-4XA

Difficult working conditions emphasize their value



Under a thick covering of talc dust, we found this motor doing a hard job—and doing it well. Conditions like this serve to emphasize the advantages and dependability of New Departure Ball Bearings. Snugly sealed and packed with the correct amount of proper grease they are mindful of one thing only . . . duty. They should not be attended oftener than once a year for their stipend of lubricant. New Departures are economical. Descriptive data gladly sent on request.

ABOVE: 150 H. P. Westinghouse motor operating strainer in rubber reclaiming plant.



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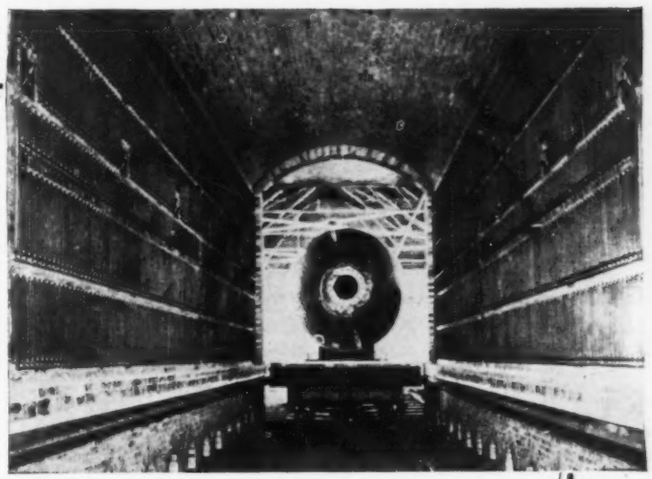
Industry is going in for *Electric Heat* in a Big Way!



3,000-kw., car type electric furnace—A. O. Smith Corp., Milwaukee

Look at this furnace, used by the A. O. Smith Corporation, of Milwaukee. No coal, no dirt, no ashes. But *plenty of heat!* And perfectly controlled. Industrial concerns, engineering contractors, consulting engineers, architectural firms, as well as public utility power sales departments, are all interested in the subject of electric heating—constantly and practically interested in it! Wherefore the pages of *Electrical World* continually contain articles, illustrations and news items relating to the subject.

Because the electrical engineers associated with the concerns just mentioned are *Electrical World* readers. » » »

From the beginning, *Electrical World* has actively promoted electric heating and misses no opportunity to demonstrate the advantages of its application.

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E.W.

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IF YOU are qualified for position between $2,500 and $25,000, and are receptive to negotiations for new connection, your response to this announcement is invited. The undersigned provides a thoroughly organized service established twenty-one years ago, to conduct confidential preliminaries, and assist the qualified man in locating the particular position he desires. Not a registration bureau. Retaining fee protected by refund provision, as stipulated in our agreement. Send name and address only for description of service. R. W. Bixby, Inc., 262 Main Street, Buffalo, N. Y.

EXECUTIVES, electrical, public utility, manufacturing, sales, office, chemical, engineering, etc. Write for particulars regarding our confidential and individual service. H. H. Harrison, Supervisor, The National Business Bourse (Est. 1915), Great Northern Bldg., Chicago, Ill.

POSITIONS WANTED

AN engineer, graduate Stevens, year and one-half General Electric test, five years' experience transmission operation, speaking Spanish fluently, desires position, preferably with operating or engineering department of utility. Available for domestic or foreign service. PW-884, Electrical World, Tenth Ave. at 36th St., New York.

RADIO engineer, specialized past four years radio interference investigations, electric utilities. Go anywhere. L. L. Robinson, 1024 So. Water St., Wichita, Kansas.

CIVIL SERVICE OPPORTUNITIES

UNITED STATES Civil Service Commission, Washington, D. C. Assistant inspector (radio enforcement), entrance salary $2,400 a year. Applications must be on file with the Commission not later than July 21, 1931.

U. S. Government

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., June 17, 1931.—Sealed bids in duplicate subject to the conditions contained herein, will be publicly opened in this office at 3 p.m., July 8, 1931, for furnishing the materials and performing the work required for installing one passenger elevator in the U. S. post office and court house, at Paris, Texas. All prospective bidders are hereby notified that, prior to the award of the contract, the right is reserved by the supervising architect to require any or all bidders to submit a "statement of facts as to qualifications to furnish elevators in strict accordance with the specifications" in detail of such data as may be required including the business and technical organization of the bidder available for the contemplated work, financial resources, building experience, material proposed to be used, etc. The United States expressly reserves the right to reject any bid in which the facts as to business and technical organization, financial resources, or building experience compared with the project bid upon, or materials proposed to be used, justify such rejection. The successful bidder will be required to furnish a performance bond of 50 per cent of the contract price. The prevailing rate of wage shall be paid all laborers and mechanics employed on the project as provided in the Act of March 3, 1931 (Public No. 798). Drawings and specifications may be obtained from this office. JAS. A. WETMORE, Acting Supervising Architect. (271)

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Electrical—Hydraulic—Mechanical

Our summary contains a complete list of equipment under above classification

WRITE TODAY FOR YOUR COPY A

Phoenix Utility Co., 2 Rector St., New York City

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Variable Speed—230 Volt—D. C.

1—200-hp. Allis-Chalmers Interpole, 500/1000.
1—150-hp. Westgh. SK-201, 400/800 r.p.m.
1—100/125-hp. Crocker-Wheeler, CMC-101H, 600/1200 r.p.m.
1—100-hp. Westgh. SK-200, 250/700.
2—100-hp. Westgh. SK, 300/1200.
1—75/100-hp. Westgh. SK-210, 200/600.
1—75/100-hp. Crocker-Wheeler, CMC, 500/1000.
2—50-hp Westgh. SK-190, 225/450.
2—35/45-hp. Gen. Elec. RLC-203, 500/1500.
1—25/30-hp. Electro Dyn. 20-S, 400/1200.
3—20/25-hp Gen Elec. RF-12, 500/1500.
5—15/20-hp. Westgh. SK-110 L, 500/1500.
4—10/14-hp. Gen. Elec. RLC-116, 400/1600.
12—10-hp. Westgh. SK-90, 500/1500.
2—7½/10-hp. G. E. NEW, RF-10, 400/1200.

See last week's listing

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A CONCISE, comprehensive course for men of ambition, complete in one year. Mathematics engineering drawing, shop-work. Students construct motors, install wiring, test electrical machinery. Fireproof buildings. 38 years' successful experience. Catalog on request.

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2500 KVA. G.E. (condensing).
1875 KVA. Wghse. (bleeder).
1250 KVA. Wghse. (bleeder).
1250 KVA. (2) G.E. (condensing).
937 KVA. G.E. (condensing).
780 KVA. Wghse. (bleeder).
625 KVA. Wghse. (40 lbs. b.p.).
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375 KVA. Wghse. (non-condensing).

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240 KVA. G.E.—16x24 Chuse 4 v.
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1—500 kw., 250 v. Westinghouse Synchronous motor Generator Set
1—300 kw., 125 v., 3-wire, 3-unit, Ridgeway.
1—250 kw., 230 v., 3 ph., 60 cy., 2300-4600 v. Synchronous Motor Generator set.
1—200 kw., 230 v., 3 ph., 60 cy., 2300-4100 v Synchronous Motor Generator set.
1—150 kw., 600 r.p.m., 250 v., Gen., 3 ph., 60 cy., 220-440 v., G. E. Synchronous motor.
1—125 kw., 250 v. Westinghouse Synchronous Gen. Motor Set, 3 ph., 60 cy., 230-2200 v.
1—100 kw., 125 v., D. C. 220-440 A.C. G E. Synchronous Motor Generator Set, 220-440 v
1—100 kw., 250 v. Gen., 900 r.p.m., 2200 Synchronous Motor

TURBINES

1—75 kva., 3 ph., 60 cy. Westinghouse Geared Non-Condensing Turbine.

TRANSFORMERS

1—1500/3000 kva. G. E. combined oil and water cooled 3 ph., 60 cy., 11000-22000-2300 v.
3—500 kva. G. E. 13000/26000—220/440.

A. C. GENERATORS

No.	Kw.	R.p.m.	Volts	Ph.	Type
1	400	900	2300/4000	3	Westg.
1	350	600	440	3	Westg.
2	125	900	2300	3	Cr.-Wh.
2	100	900	230-2300	3	G E.
1	75	600	220	3	Westg.
1	75	900	2300	3	G E.
1	50	1200	220-440-2300	3	G E.

MOTORS—3 Phase, 60 Cycle

No.	Hp.	R.p.m.	Volts	Type
1	500	900	440/4000	(Westg. Syn. Con.)
1	500	900	440	G.E. syn.
1	350	900	2200/4000	Wh. syn.
2	300	600	445-2300	G.E. syn.
1	250	600	2200/4000	G.E. syn.
1	250	600	220-440	Westg. syn
1	250	600	440-2200	G.E. syn.
3	200	514	4150-2300	G.E. syn.
2	175	3 ph.	60 cy	2300 volts, G.E.
4	150	1200	220-440	Westg. rg.
1	150	900	2300	G.E. syn.
2	150	514	2200	Westg. sl.rg.
1	150	1800	2200	Westg. sq.cg. mtr.
1	100	900	440-2200	G.E. sq. cg.
1	100	900	220-440-220	Westg. sq. cg.

D.C. Generators

No.	Kw.	R.p.m.	Volts	Type
1	200	900	250	G.E.
1	200	600	250	G.E.
1	200	525	250	G.E.
2	150	1200	250	Cr.-Wheele
1	150	600	250	G.E.
2	150	1200	250	Westg., new
1	100	720	250	G.E.
1	75	450	250	Dieh

(Smaller Sizes on Request)

D.C. MOTORS—230 VOLT

No.	Hp	R.p.m	Type
1	250	550	G.E.
2	200	1150	Cr.-Wheeler
1	150	600	G.E.
3	150	850	Westg. SK, new
1	150	1100	Westg. SK.
1	125	550	Cr.-Wheeler
1	100	625	Westg. Type S

(Smaller Sizes on Request)

D.C. MOTORS—125 VOLT

No.	Hp	R.p.m.	Type
1	125	575	G.E.
1	100	600	G.E.
1	80	600	G.E.

SLIP-RING MOTORS, 3 PH., 60 CY.

Hp.	Volts	Make	Speed
220	220–440	G. E.	450
200	440–220	G. E.	600
150	2200–440–220	G. E.	514
150	220–440–550	G. E.	600
100	550	Westghse.	900
100	2200	Westghse	900
100	2200	G. E.	720
100	550	G. E.	720
100	440-220	G. E.	720
100	440–220	G. E.	900
75	440–220	G. E.	600
60	440–220	G. E.	720
50	440–220	Westghse.	720

SYNCHRONOUS MOTORS, 3-PH., 60-CY.

300	440	G. E.	225
240	2200–440–220	G. E.	720
240	440–550	G. E.	600
150	2300–4000	G. E.	900
110	2200–550	G. E.	900
80	2200–440–220	G. E.	1200

MOTOR-GENERATOR SETS AND ROTARY CONVERTERS

1—300-.kw.,250-v., 1200-r.p.m. G.E., connected to 2300-440-v., 3-ph., 60-cy., synchronous motor.
1—100-kw., 250-v., 6-ph., 60-cy., 1200-r.p.m., Westghse., with 2300-v. transformers.
1—50-kw., 125-v., 1200-r.p.m., G. E., R. C., connected to KT, 2200-440-220-v., 60-cy., squirrel cage motor.

A. C. GENERATORS

1—225-kva., 600-r.p.m., 240-480-v., G. E.
1—187-kva., 720-r.p.m., 2200-440-220-v., G. E.
1—150-kva., 900-r.p.m., 2200-480-240-v., G. E.
1—120-kva., 900-r.p.m., 2300-4000-v., G. E.
1—112 ½-kva., 900-r.p.m., 2200-240-480-v., G. E.
1—75-kva., 1200-r.p.m., 2200-480-240-v., G. E.
1—56-kva., 1200-r.p.m., 240-480-v., G. E.
1—50-kva., 1200-r.p.m., 2300-480-240-v., G. E.

ENGINE GENERATOR SETS

1—Ames uniflow—G.E. 312 kva., 200 r.p.m. 2300-240-480-v., 3-ph., 60 cy.
1—Ames uniflow—G.E. 120 kva., 225 r.p.m., 2300-v., 3-ph., 60 cy.

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SALES AND REPAIR SERVICE

Low Prices—Prompt Shipment

A complete stock of transformers 1 to 1000 kva. Modern methods make our repair service second to none. Special service on breakdown jobs.

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"America's Used Transformer Clearing House"
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We Buy Modern Type Transformers

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3750 kva. Gen. Elec. condensing.
1875 kva. Gen. Elec. extraction.
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625 kva. Allis to Kerr NEW.
625 kva. Gen. Elec. condensing.
375 kva. Gen. Elec. non-condensing.
250 kva. Westgh. non-condensing.

MOTOR GENERATOR SETS

200 kw., 600 v. to 3 ph., 60 cy. Westgh.
200 kw., 250 v. to 3 ph., 60 cy. Gen. Elec.
100 kw., 250 v. Allis to 3 ph., 60 cy. Elec. Machy. Co.
50 kw., 65 v. to 3 ph., 60 cy. West. Elec.
45 kw., 125 v. to 3 ph., 60 cy. Westgh.

ROTARIES

300 kw., 600 v., 6 ph. Westgh.
300 kw., 250 v., 6 ph. Westgh.
200 kw., 250 v., 6 ph. Westgh.
165 kw., 250 v., 6 ph. Gen. Elec.
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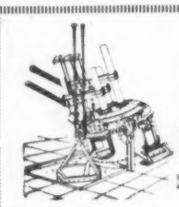

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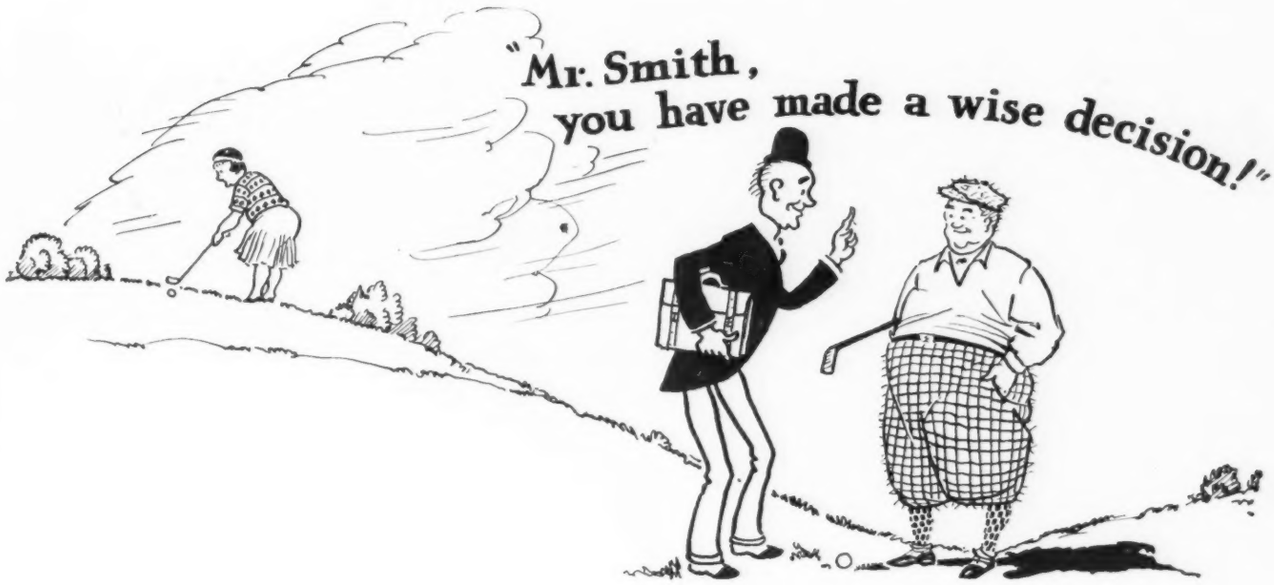

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